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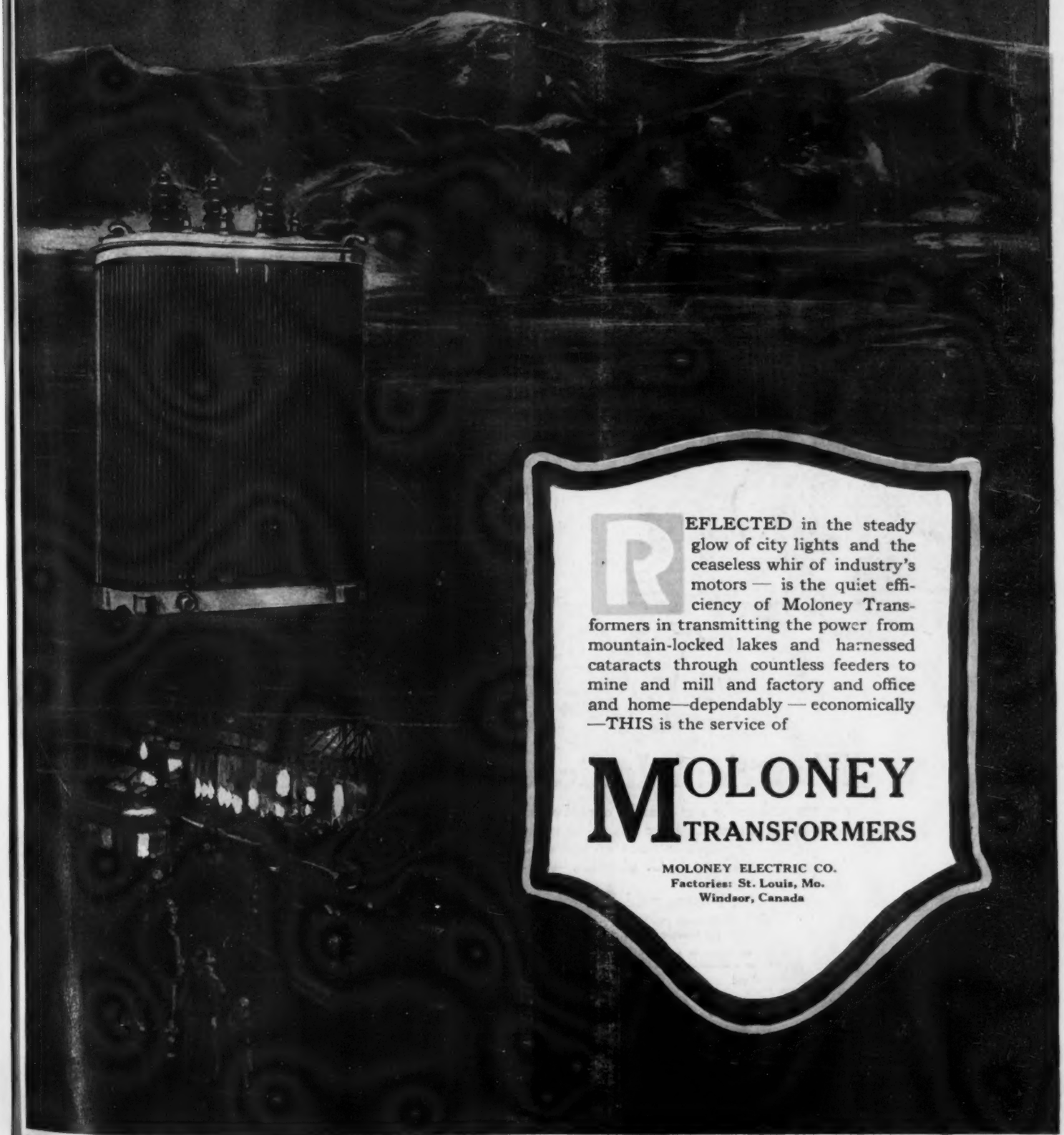

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Electrical World

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Development of Water Power an Economic Necessity

THE development and utilization of the water powers not only of this country but of the world is an obligation and a duty devolving chiefly on the engineer. On the electrical engineer in particular does the obligation press most heavily, because he is peculiarly fitted by training to make the most of the latent powers of the streams and waterfalls and to transmit the energy thus generated to points of utilization with the least possible loss.

Why, then, are water powers still flowing to waste and why are coal and oil still used in such huge quantities for power purposes? Is it because the electrical engineers are not alive to their opportunities or are remiss in their public duty? To ask the question is to answer it. The profession is noted for its energy and for its promptness in responding to public needs. It is willing to spend and to be spent in the service of mankind and is ever seeking new fields of endeavor and obligation. Neither negligence nor a desire to shirk responsibility can be laid to its charge. The reason for our undeveloped streams and falls lies elsewhere. The restraining hand that has held back enterprise and deprived industry of electric power is lifted by some one else.

The Conversion of Congress

Up to the present the government has been the chief retarding influence and has worked against the interest of the people, imposing restrictions that have made it impossible to obtain water-power development. Apparently Congress has at last seen a great light, and before long the intolerable condition which has prevailed will be remedied. When the enacting legislation now awaiting the agreement of the conference committee of the House of Representatives and the Senate is passed—and it cannot be passed too quickly—and has received the Presidential sanction, water-power development should go forward by leaps and bounds.

Approximately 5,000,000 hp. on the navigable streams of the land awaits engineering enterprise. Of course, it must be recognized that water powers cannot be developed everywhere without regard to competing conditions. Coal is still plentiful and the great industrial centers of the country still depend for the most part on electricity generated from this source, but with the rising costs of coal and labor the situation becomes more and more favorable for water-power development, and the interconnection of systems and the improvements in the art render transmitted energy less and less subject to interruption. Unfortunately, water power does not always abound in sufficient quantities where the power is most needed, nor is it always within transmitting distance; but where it is to be found and economic conditions at all warrant it water power should be developed.

Dangers Inherent in Delay

The rapid extension of transmission and distribution networks brings more and more water power within the range of possible development, and in the congested districts all streams and waterfalls should be harnessed and contribute their quota of electricity to the needs of the community. Naturally, with the high prices prevailing there is a tendency to wait until conditions are more nearly normal before undertaking new work. That is why more construction is not now under way. In the public utility field, however, delay is dangerous. Power requirements must be met, and it is incumbent on public service corporations to supply all needs. No community or industry should be kept back or handicapped for want of power, and no utility operating in a state possessing a public service commission is justified under normal conditions in restricting service.

The Public Need Comes First

While it is true that there are limits to the amount that should be paid for equipment and labor, especially in public utility work which is to last and on which rates will have to be predicated, still the public need is uppermost, and inasmuch as all expenditures must be sanctioned by the commission, rates based on high costs must be sanctioned also. From one end of the country to the other there is a growing shortage of power because electric public utilities have not kept abreast of the demand. In many cases the fault is not theirs, but is due to war and after-war conditions. The fact remains, however, that a shortage exists, and this should be remedied as speedily as possible by the installation of more equipment, preferably hydro-electric equipment if water is available in a degree that makes its employment economical.

Money Must and Will Be Found

With the enactment of the pending legislation it should be easier for public utility companies to obtain money for hydro-electric development. In fact, it can be shown that the prosperity of whole communities and sections of the country depends on the continued growth and expansion of hydro-electric systems, so that chambers of commerce and public service commissions and other bodies should, as a public duty, see to it that money for building the developments is forthcoming. It is not always appreciated how greatly the community is indebted to the public utility company. When once this obligation is brought home to the community there is no doubt of the proper support. This is one of the bright sides of public utility work and means much for the development of our hydro-electric resources.

Regulation Extended to Employees

THE Public Utilities Commission of the State of Kansas has been superseded by a Court of Industrial Relations, which is founded upon the principle that government should give society the same protection against the consequences of industrial strife that it gives against recognized crimes. The powers vested in the court are very broad. Public utilities, the mining and production of fuel and the manufacture of clothing and food products are considered basic industries. Their operation is placed under the control of the court in the interests of the general public. Living conditions of employees and a reasonable minimum wage for them are among the things that come under its jurisdiction.

To the court has also been given more authority over the operation of public utilities than was vested in the public service commission, and none of the powers of the latter appears to have been taken away. Under the new law it is now a misdemeanor for any person, firm or corporation engaged in the specified industries to curtail or stop operation, and it is likewise unlawful for workers or others to hinder, limit or suspend continuous and efficient operation of these industries.

It is gratifying to see that a fundamental rule of the entire central-station industry—namely, that service must be maintained at all costs—has been adopted by the State of Kansas and made law. Kansas has by this measure probably gone further than any other state in an attempt to protect the general public from the effects of labor troubles. However, it can be enforced only by and with the consent of the governed, and its success and permanence will depend upon the manner in which the judges administer it.

Drift of Hydro-Electric Design

TWO broad influences have been at work modifying hydro-electric design since the early days of the art that have a definite bearing on future projects. The first of these is the growth of the transmission network. The second is a greater freedom of design both in generators and waterwheels. In the early days, W. M. White points out in this issue, each plant was independent and had to be so planned as to obtain the best and most reliable running conditions. Consequently the number of units was planned with reference to the sound canonical rule of so distributing the output between several units that one of them might be put out of action without seriously imperiling the load. This meant usually three or four generators. As conditions now exist a great interconnected network rather than a single station can be treated as the unit, and its sources of supply must be so constituted as to obtain maximum continuity of service in the simplest way possible. This means that of its generating stations none need be independent in the old sense, and it is often just as well to put the whole output in one or two units, provided that the conditions are favorable. The whole plant is operated by a load dispatcher, and it makes little difference to the network whether a spare generator is held in reserve in one place or another.

The second feature of modern design is that the efficiency of generators and, particularly, of waterwheels has been very materially increased. Wheels are in use today such as no designer imagined a quarter of a century ago in point of high efficiency over a considerable range of output. Moreover, the dynamo designer is less fearful of low speeds than of old. Construction has been standardized in a way that makes it feasible to get the speeds of waterwheels and generators together without violation of technical proprieties. It used to be necessary to pick out a standard generator of as nearly the required output as possible and then to couple on wheels as nearly standard as possible to obtain the necessary output and speed. Sometimes this led to very unhappy hydraulic conditions with serious loss of efficiency. Today, and particularly in connection with the large units called for by the practice just mentioned, it is feasible without unreasonable expense to make generator and wheel to fit each other, with much gain in efficiency and simplicity of general station layout. Owing to this tendency the vertical-shaft wheel has come back again into favor and where conditions are favorable with very great utility. Oftentimes the hydro-electric problem, particularly if it does not involve great magnitude, can readily be solved by a horizontal wheel and standard generator, but the trend of practice is steadily toward building the whole set as a unit. An incidental improvement which is of considerable moment is the development of turbines for fairly high heads, bridging the gap which had previously existed between the field of the impulse wheel and that of the turbine proper.

Public Utilities Must Be Allowed to Earn More

AFTER years of delay there seems now a prospect that a reasonably sound and fair water-power bill will become law. The pity is that it has been so long delayed, the procrastination causing untold loss to the country. While our industries were struggling under the strain of war and the fuel supply was disastrously short, literally billions of kilowatt-hours were streaming downward unused into the sea. Such loss is sheer economic waste, irretrievable, inexcusable. The disastrous outstanding feature of the situation, even as it is today, is that it is by no means so easy to establish hydro-electric plants now as would have been the case five years ago. We publish this week two comments on the subject by consulting engineers of national reputation. Both bring to the front the same story of the financial difficulties which beset our belated developments. We are in a period of wild inflation, with the value of the dollar settled on about a fifty-cent basis and the price of the necessaries of life rocketing sky-high. Electric power supply is about the only thing important to human industry of which the price has not been materially increased. Relatively at least, the price of electricity is too low to permit the financial returns which are due to those who invest in hydro-electric developments. The cost of construction has substantially doubled during the period of inactivity. The cost of operation, fortunately not so large a factor in hydro-electric plants as in those deriving their power from fuel, has considerably increased, but public utility revenue has not kept pace.

Public service commissions have been disposed to take the attitude that power companies should be limited to about 8 per cent return on the invested capital. What one of all the great manufacturing industries which have grown up within the past five years could stand such a limitation? In order to attract capital to hydro-

electric developments it is necessary to adopt a more generous attitude—to give the investors a fair and liberal return on the money actually put in, and to make full provision as well for the upkeep and necessary depreciation of the property.

With the prices of coal what they are and are likely to be, there is an opportunity for the profitable development of water powers if a fair financial chance is accorded. H. L. Cooper, the author of one of the articles, notes that as things stand today, even with the enhanced cost of material and labor, hydraulic plants can compete favorably with steam power, and the chances seem to be that with rising costs of fuel this advantage will be retained. One advantage besides must not be forgotten, that there has not yet been a single interruption of electric transmission service due to strikes, owing probably to the comparatively small amount and superior grade of labor necessary to successful operation. The prospects for development are not what they were five years ago and the losses of the past can never be recouped, but we are still hopeful, and if the regulating commissions will lend a hand and see that capital invested in this all-important industry shall have a square deal, immense benefits to the public may still accrue.

Losses That Occur in Shipping Coal

UNPLEASANTLY large losses have recently been experienced in shipments of coal received. A good many central stations have felt the effect of them somewhat severely, one manager reporting losses in winter as high as 8 per cent as between the coal reported when loaded and that actually received, and, from his experience, judging that the average shortage through the year would run between 4.5 and 5 per cent. Losses of this magnitude cease to be a casual matter readily to be overlooked. They may easily amount to thousands of dollars a year and deserve searching investigation. An inquiry of the traffic manager of the National Coal Association brought out the statement of fact which we lay before our readers in this issue. To begin with, it is clear that one does not weigh coal on a chemical balance, and a certain variation must necessarily be allowed. This is customarily 1 per cent and often 5 per cent, for evaporation.

The principal diminution of weight is reported to be losses in transit from coal loaded too high and shaken out during switching operations. This would indicate careless loading and handling. Then, too, there may be leaks in the cars which might affect fine coal to a very material degree. A little investigation of the losses as affected by the kind of coal shipped might prove illuminating. Theft and incomplete unloading of cars used for other purposes than coal also have their part in the final discrepancy. The loss from theft is not to be overlooked at the present time when a few shovels of coal have a very perceptible value. The main question is, What is to be done about it? Probably rigorous following up of the losses and filing the appropriate claims will have more effect than anything else, particularly since the railroads have been turned back to their rightful owners and there is a definite responsibility. The station manager who raises his boiler efficiency 5 per cent has cause to congratulate himself, and if he can make a similar gain based on the coal paid for, the opportunity assuredly should not be neglected.

Charging Duty on Scientific Apparatus

HOUSE bill No. 7785, which has recently been reported to the Senate without amendment by the committee on finance of the Upper House, establishes duties of 60 per cent ad valorem on chemical glass and porcelain ware and surgical and dental instruments and 45 per cent ad valorem on optical glass, optical instruments and scientific apparatus generally. The war brought us to a sudden and somewhat startling appreciation of the extent to which we had come to depend on importations, particularly from Germany, of these vital tools of the scientific trades. Under the sudden stress American manufacturers responded with a degree of success which is altogether remarkable. Even optical glass, the manufacture of which is of peculiar difficulty, was, before the end of hostilities, turned out in large quantities and of highly creditable quality considering the speed with which the industry had to be built up almost from the very beginning. It is well that protection has been accorded it. The most striking feature of the new bill is that the free list previously extended to educational institutions is now suspended. The wisdom of this step has been much called in question, but it is undoubtedly a fact that this free entry has been one of the grave hindrances to American manufacturers in the home production of scientific apparatus.

In certain classes of instruments, including a large proportion of those used in electrotechnics, the American manufacturer has attained well-deserved supremacy and foreign competition cuts comparatively little figure; but this is not true of all branches of scientific manufacture. Certainly we in the United States do not want to be again dependent on Germany, or any other country, for our means of research. There is, however, one phase of the matter which ought to be very carefully considered before the bill is finally passed. It is an unfortunate fact, owing perhaps in some measure to the former free list, that certain classes of scientific apparatus have never been made at all in this country and perhaps are unlikely to be put into regular commercial production as they are abroad. An import duty on such apparatus is a tax on research which does not benefit any American manufacturer nor can it do so until he puts such apparatus into production and thus actually has to face competition. Would it not be the part of wisdom therefore, to insert in the bill a clause granting free entry to apparatus not at present manufactured in the United States or patented here until such time as American makers seriously undertake its production? As soon as it can be obtained from the American source in regular course of manufacture let it take its place under the specific duty provided. We do not mean by this that special pieces of apparatus of peculiar pattern, manufactured abroad and which some one here may prefer when American articles substantially of the same grade are available, should be granted this free entry. If it is merely a matter of paying for a fancy, the American should be a "good sport" and pay the tax. One could make, however, a very considerable list of apparatus which, generically, is not in production on this side of the Atlantic, and it is to such apparatus that this suggestion applies. The American manufacturer should be fully protected on the products he makes not only on general principles but to help the country's industries. However, research in this country should not be taxed merely for the petty cash account of the Treasury.

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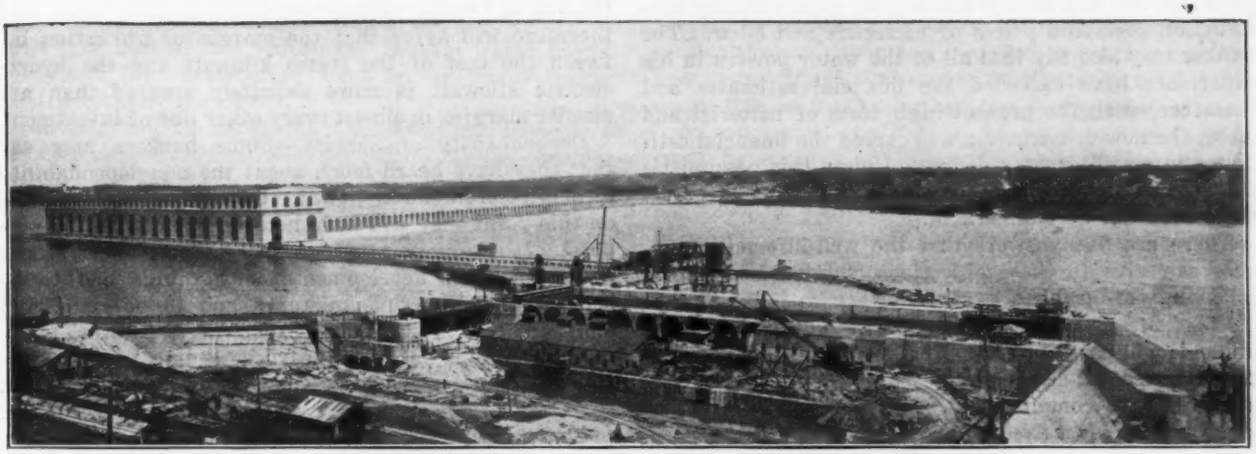
William States Lee

A Southerner whose leadership and engineering ability have pioneered the way in water-power development and electrification of industries in the South

AT ANDERSON, S. C., in 1898 the first 11,000-volt generators to be installed in this country were placed in operation in the Portman Shoals plant of the Anderson Water, Light & Power Company on the Seneca River. William States Lee, who was graduated from the South Carolina Military Academy four years before, was in charge of this work as resident engineer. This marks the beginning of his career in the development of Southern water powers and the building of a system which now includes eight hydro-electric and four steam plants, totaling 280,000 kva.; 2,050 miles of transmission lines, and 201 outdoor substations operated by the Southern Power Company, of which he has been vice-president and chief engineer for the past fifteen years. Mr. Lee gained his reputation as an engineer through his dogged persistence and success in damming the most treacherous streams of the South about twenty years ago. His work at India Hook Shoals on the Catawba River, near Rockhill, S. C., where in 1904 he completed a concrete dam after three contractors had failed owing to quickly rising floods, and the plans for future electrical developments in the section which he unfolded at that time to J. B. Duke, himself a North Carolinian, led to the formation of the Southern Power Company in the spring of 1905. The subsequent creation of the extensive system of that company has been due to the financial assistance and interest of Mr. Duke in developing Southern industries on the one hand and to the engineering vision, indefatigable perseverance and executive ability of Mr. Lee on the other. The accomplishments of these two men through the able staffs they have created, without outside financial or engineering assistance or absorption of other organizations, stand unparalleled in this country among achievements involving the design, construction and operation of large generating and transmission systems. Other details of Mr. Lee's part in this work are given on page 699 of this issue.

Financing Water-Power Developments

By HUGH L. COOPER
Consulting Engineer, New York



Cost of Construction, Return on Investment, Relation of Estimates to Actual Cost, Competition with Steam Power, Dependability of Service, Ability to Obtain Labor, Return During Development

THE world is going through the wave of unrest which has repeated itself all through history after every great war. It is difficult to analyze the many causes, but whatever they may be, we shall eventually learn after the upheaval has subsided that increased production along all fronts, individual as well as collective, accompanied by frugal ways of living, reduced the aggravating condition—high cost of living. Therefore why not take the bull by his horns and eliminate under-production by directed intelligent effort rather than let the situation clear itself automatically by a long-drawn-out and painful process? In this problem engineers can do more than any one else by developing and extensively applying labor-saving devices. To do this, however, involves keeping the power supply up to the demands of industry.

The writer is of the opinion that one of our greatest aids in the present situation will be to develop water power all over the world wherever such developments are economically warranted. Aside from providing the much-needed power, hydro-electric plants would save many thousand tons of coal—which is fast being exhausted—and would release considerable coal-carrying equipment on railroads for other purposes. For example, the development of 1,000,000 hydro-electric horsepower would release about $60,000,000 worth of railroad equipment. Besides, for every 35 hp. developed there will be a saving in labor of one man every year compared with the labor required for steam-power generation (based on a ratio of one to eighty-five for large water-power and steam-power plants respectively). The foregoing results are just a few of the many distinct aids that can come to the present situation by the development of water powers, both foreign and domestic.

The reader may very properly inquire why water powers are not being developed in the United States at top speed. The coal costs all over the world have advanced from 80 to 500 per cent, and there is now no relief in sight to correct the ever-increasing tendency to still higher prices. As a result there is a world-wide demand that water powers be everywhere developed as rapidly as possible, and the call is made to private capital to engage in this work, for the all-sufficient reason that it can be carried out most economically from the consumers' standpoint by private capital properly regulated as to rates and service.

Enabling Legislation Expected Soon

Water-power development in the United States has been practically at a standstill for the last twelve years. This lack of development is a direct result of the absence of enabling legislation. Engineers all over the United States have been trying for twelve years to secure constructive legislation, but their efforts up to date have been abortive because of the great skill as obstructionists of a lot of well-meaning cranks who appeared on the scenes twelve years ago and have since actively and successfully opposed water-power legislation on the silly and erroneous theory that there was a water-power trust in our country that was trying to grab up all of the water powers and develop them entirely in its own interest. The skill of these obstructionists has been very remarkable, but it is only one case among many that might be enumerated where a small well-organized minority has been able to bamboozle a great majority and make the latter suffer widespread financial loss.

What price the public will pay for those twelve years of failure to develop our water powers it is not worth while at present to conjecture, because now the lost power is mostly sea water. What concerns us most is new construction that will increase production, and as it now seems likely that Congress and the President will at an early date give us satisfactory water-power legislation, the hydro-electric engineers will probably be called upon at an early time to get busy.

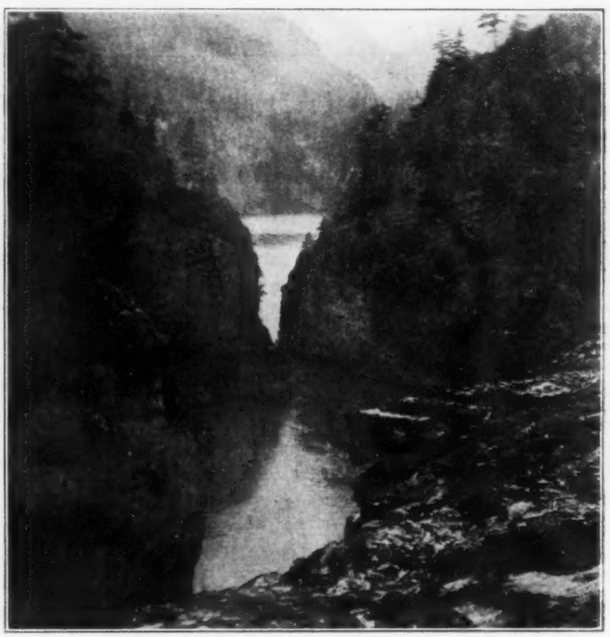
In the United States are many undeveloped water powers the development of which is justified even in the face of present-day greatly increased costs of labor and materials. After the hydro-electric engineer is certain that he has found a water power that can be justifiably developed the next problem is to find the

funds required. However, he will find that the banker is the same old pessimist he used to meet and will have a lot of new objections to furnishing the money. The principal one will be the abnormally high existing construction costs and prices of materials and labor. The banker may also say that all of the water powers in his experience have exceeded the financial estimates and therefore, with the present high costs of material and labor, the new construction will exceed the financial estimates in a still greater degree. Unless this pessimistic contention is overcome, the rest of the banker's objections need not be enumerated.

There are five answers that the well-informed engineer can give to these objections, summarized in the following paragraphs:

Fixed Minimum Return Assured.—The water-power bill as it will pass Congress provides for absolute regulation of rates and service by public service commissions and provides for a fixed absolute fifty-year term franchise and for a minimum reasonable rate of return on the cash cost of the work. It also provides that at the end of the fifty-year term, if the owners cannot agree with the government on the terms of a new franchise, they shall receive back the total amount of their net investment less any amortization that has accumulated above the reasonable return on the net investment named in the original lease.

Thus the banker can pass in advance upon the attractiveness of the minimum rate of return specified in the lease and the opportunities provided in the lease for earnings in excess of this minimum rate.



SKAGIT RIVER, WASH., WHERE WATER IS NOW BEING IMPOUNDED FOR 200,000-HP. DEVELOPMENT

In examining this question the banker will have in mind the sale of the proposed securities to his clients, who as such are entitled to a very conservative estimate of all the risks involved. If he finds the minimum rate of interest attractive, then he only has to make certain that the proposed plant shall be capable of earning this rate of return in competition with steam, provided, of course, that he has made certain that the estimate of the cost of the hydro-electric plant was made by engineers whose past records warrant the use of their figures.

Relative Cost of Water and Steam Power.—Based on present-day costs of construction, material, labor and coal, a kilowatt-hour from central steam stations will cost an average of one and a half times the cost of a kilowatt-hour from water power*. Consequently the banker will find a margin of protection of approximately 50 per cent over the nearest competitor, which is steam. Considering this margin, the banker will hardly take the position that steam costs can ever be reduced to a point below present hydro-electric costs, especially when all tendencies are in the direction of larger returns to labor. The banker will undoubtedly accept the view that it will take the world a long time to recover from the loss of twenty million men in the last six years, and therefore will agree that the margin of protection between the cost of the steam kilowatt and the hydro-electric kilowatt is more definitely assured than are similar margins in almost every other line of investment.

Dependability of Service.—Some bankers may say that they have heard much about the non-dependability of service from water power. Unless they are satisfied on this point they will have nothing to do with the proposal. It can be pointed out that in the pioneer stages of water-power development many things had to be learned and numerous mistakes had to be registered and paid for. Out of this experience, however, many valuable lessons have been learned, so that today water-power development is a science and not a gamble. Proof beyond question can now be submitted that the service dependability of hydro-electric plants in modern existing installations is at least equal in reliability to that of the modern steam station.

The objection is sometimes raised that some hydro-electric developments in the past have been very disappointing because of mistakes in estimating the quantity of water that was available for power purposes. The banker and his investors can be protected against this contingency, however, by dealing only with engineers whose records justify confidence in their predictions.

An outstanding difficulty in the past has been the failure to recognize that hydro-electric engineering is a specialty by itself. Water powers have been disappointments to some bankers because they have assumed that inasmuch as the engineers speaking to them were eminent as railways engineers or in some other line they knew all about water-power development too. In such cases the banker is quite as much to blame as the engineer.

Obtain the Labor to Develop Water Powers.—Another question that may arise is "Where are you to get labor to build anything these days?" To this the ingenious and progressive engineer will reply that construction methods and machinery have been devised which greatly reduce the amount of labor required, and that the length of time required for hydro-electric construction is great enough to justify the adoption of construction methods that will attract the best character and the necessary amount of labor. Because of the smaller amount of labor required by the modern methods of construction more attractive wages can be paid.

Return During Development.—Finally the banker may say that he does not want to put any money into water-power construction because it will take three or four years to complete the work. The answer is found

*The writer has records available to substantiate this statement, but space does not permit including them in this article. Data to back up this and other statements will be presented later.

in the fact that interest during construction is just as much a part of the net cost of the enterprise as the cost of the cement and, therefore, that the net investment upon which the banker is entitled to the specified return will take care of this objection. Several water powers proposed for construction have an abundant market waiting their completion.

In addition to answering the foregoing answers to objections, the engineer can enumerate for the consideration of the banker some of the unusual advantages inherent in water-power securities.

BENEFITS TO GENERAL PUBLIC

The first big advantage relates to the fact that the power consumer is immediately saved a very large amount of money compared with his steam costs. The sale of a million new horsepower, financed under present conditions, in the United States will save to the consumers thereof more than $30,000,000 annually. Certainly such a fact will cause water-power securities to be looked upon with special favor by those concerned about sound economics.

Another point that the water-power engineer could emphasize to advantage is the freedom of hydro-electric operation from strike interruptions, first because the number of employees required is relatively very small and second because it is not dependent on fuel of which the supply may be interrupted by strikes. Up to date the history of hydro-electric operation does not record a single interruption from strikes. The banker will see that future costs of water-power production can be influenced only in a very minor degree by increased costs of labor.

Another appealing point about water-power securities is the fact that where dams are built for storage or on navigable streams distinct aids to inland navigation are created. In virtually every case these improvements to navigation are made without public expense, and water thus stored has its effect in reducing the amount of flood damage that occurred annually before the water power was developed.

Other broad benefits to the general public could be enumerated if space permitted. Obviously water-power securities are sound as to legal structure and as to their ability to fulfill the promise made. Such securities are certain to have an increased and unusual value to the investor when he knows that the basis of his security is conferring increased efficiency, increased production and conservation of labor and coal and promoting countless needed industries that could not otherwise exist, and is doing this at a period when the world needs such aid.

In conclusion, the banker may say to the engineer, "You have given me a considerable number of good reasons for the development of water power. Now be honest with yourself and with me and tell me what harmful influences may be set in motion thereby." Two possibilities may be considered—(1) damages to overflowed lands and (2) the loss of production that is caused by this overflow. The first drawback is virtually negligible and is so far outweighed by the corresponding benefits that it should be ignored. The remaining objection loses much of its importance when it is considered that some farmers whose lands abutted a water power in the Central West complained bitterly of the fact that as a result of the water-power development their farms were increased in value so much that they had to pay considerably more taxes than they did before!

COLUMBIA RIVER, WASH., AT PRIEST RAPIDS

Development at the Dalles on this river would rival the Keokuk plant in rating. However, financial conditions and the necessity of creating a market are delaying this development

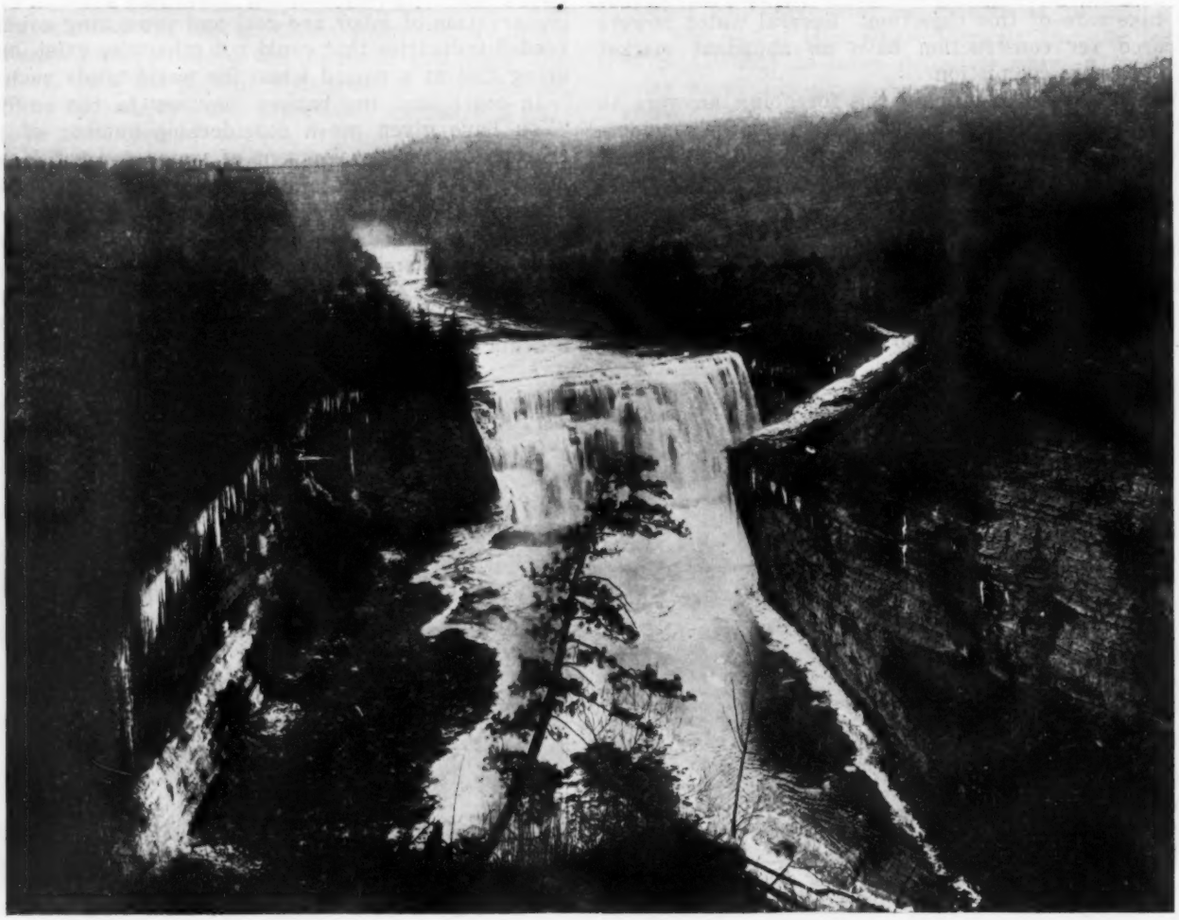
Cost of Preparing Pulverized Coal

THE data presented below were prepared by E. P. Mathewson and W. L. Wotherspoon in connection with the investigation of the use of pulverized coal for blast furnaces, but the cost of preparation is one of importance in steam-raising plants as well.

The cost of preparing pulverized coal will vary considerably, as there are several factors bearing on the matter, among which are labor, power, fuel for drier and repairs, in addition to interest and depreciation on buildings and equipment. The energy required for crushing, drying, elevating and conveying the pulverized coal will be about 20 hp.-hr. per ton of coal handled, and with modern equipment under average conditions the cost will be about 8 cents per ton-hr.

At the International Nickel Company's smeltery the average cost of preparing and delivering the coal to the furnace, in 1913, was as follows: Labor, $0.15; energy, $0.10; repairs, $0.145; coal for drying, $0.055.

100,000 Hp. Capable of Development in These Rivers



Sites exist on the Genesee River in New York State, in a region of large power demand at which approximately 35,000 hp. could be developed. The utilization of the power available would save the equivalent of coal and benefit industry. Water power can be developed on the Potomac River within the District of Columbia that will give about 66,000 hp. half the time and 10,000 hp. continuously at minimum flow. This development would be within transmitting distance of Washington, D. C., and Baltimore, Md., and would eliminate the burning of considerable coal.

Water-Power Development Must Come

Bill Now in Conference Removes Certain Obstacles, But Serious Impediments Still Exist Which Must Be Removed Through Public Enlightenment—Hydro-Electric Power a National Necessity

By an Eminent Consulting Engineer

MUCH of the present-day coal shortage, congestion of railroad traffic and general industrial delay might have been avoided if an active development of water powers had been in progress during the last twelve years. Fortunately, the present Congress has tried to undo the incalculable economic damage which has been inflicted on industrial America by past legislative prejudice, would-be reformers and other forces in this country, and it is quite certain that the water-power bill now in conference will soon become a law. While this bill removes some of the big obstacles which have stood in the way of the water-power development, it remains to be seen whether there will be the expected stampede to bring about development. Other serious obstacles have arisen in very recent years. The high cost of labor and materials, labor shortage and the high cost of construction money, combined with the excessively low rates at which power is sold, may be insuperable obstacles unless the economic conditions shall be radically changed.

The cost of power from a water-power plant consists chiefly of the fixed charge on its construction cost. Under present conditions not only are construction costs about double what they were before the war but the interest rates on construction funds even if obtainable are unprecedently high. Even operating companies of established earnings are obliged to pay 7 per cent and 8 per cent for money for extensions, refunding, etc., and a new water-power enterprise, if it could be financed at all, could only obtain capital by paying an interest rate directly or indirectly considerably higher than that. Therefore, with the combination of double construction cost and double interest cost, together with high operating labor expense, a prospective water-power enterprise is likely to show a power production cost four times that prevailing before the war.

Unfortunately, the market price for power has not been allowed to increase in this same proportion. This condition confronts virtually all the power companies of the country. The result is that the only power-plant construction being carried on at the present time is that of absolutely necessary extensions which power companies are obliged to make to maintain their position. Where such extensions are made the lowest possible first cost controls, which means that a steam plant must be installed. In general, little provision is being made to meet future demands for power despite the fact that industrial demands are doubling almost every five years. Power companies cannot afford to lag behind this rate of growth, nor can the public as a whole afford to place any impediment in their way that will obstruct electric service development.

The Fundamental Obstacle to Power Development

The fundamental difficulty with the power business, a difficulty which has been steadily increasing for ten years, is that the profits of the business are not sufficiently attractive and are not comparable with those derived from other forms of industrial enterprise. From the majority of systems power is being sold at too low a rate and below its fair value to industry. The narrow-minded position taken by some power consumers, working through the public service commissions, has held power rates down to a point where many important power systems are facing financial starvation. As a result the power business has ceased to be an attractive field for the investment of new capital and is not receiving for itself a proper share of the profits of industry in general.

Industry in this country has to a great extent built itself up on the shoulders of the power distribution systems and has been free to take for itself an unrestricted profit. It has, however, constantly and increasingly denied to the power system the right to share even a reasonable part of such prosperity. Fabulous profits have been made from such industrial plants, but the power company, tied down to the limit by regulation and restriction, has been obliged to struggle along, selling power to these prosperous factories at a figure little above actual cost and faced at all times by serious financial difficulties. Such a situation is not reasonable and in the long run is against the best interests of the consumer of power.

The point of view of industry as a whole with respect to the power company seems to be wrong. The consumer of power, a manufacturer for instance, pays a liberal profit to the corporation which supplies him with raw material. If he sells wholesale, he expects the retailer to make a liberal profit. When, however, he purchases his power, the most basic of all his raw materials, he denies the right of the power company to make more than a profit which he himself would consider trivial in his own business—a percentage of profit which would soon put a manufacturer out of business.

The doctrine often proclaimed by public service commissions that the total earnings of a power company must not exceed 8 per cent on the invested capital is both stupid and destructive. No manufacturer would think of entering business on any such restricted basis, and the power business is little different from manufacturing enterprises and is subject to many of the same contingencies.

Few power companies can exist in a healthy financial condition with earnings so restricted. They should be permitted by the regulating commissions to earn enough to pay out a liberal return in interest or dividends and in addition a sufficient amount for ample maintenance and for the accumulation of surplus. Only in this way can power companies establish the credit necessary for obtaining promptly the funds for extensions to meet the demands of industry. It will be greatly to the advantage of power consumers if they can look at the matter broadly and assist in bringing about this result.

Power companies are partly to blame for the circumstances in which they find themselves at the present time. Many of them have underestimated their real

costs in delivering power and have allowed precedents to be established in low power rates which have been difficult to overcome. One cause of excessively low prices for power has been the competition between central-station power and the theoretical cost to the consumer of producing power from a power plant of his own. Such estimates are almost always fallacious, but the power companies in their desire to sell their output have too often surrendered to the argument. Even if an isolated power consumer can correctly figure the cost at which he could produce his own power, he should be willing to pay the power company a higher price in order to avoid the investment and complication of entering the power business himself. In the long run it will pay him well to do so.

In most industries, according to an extensive analysis presented in the ELECTRICAL WORLD of Sept. 20, 1919, the cost of energy for most manufacturing purposes is less than 2.5 per cent of the total value of products, being only 0.2 per cent for tobacco, 0.6 per cent for leather, 0.8 per cent for lumber, 1 per cent for vehicles and food, 1.3 per cent for textiles, 1.8 per cent for liquors, 2.2 per cent for metals except iron, and 2.4 per cent for paper and railroad repair shops. If power rates were even double throughout the country, the selling price of most commodities should not be materially increased. Therefore, a substantial increase in power rates would not be a handicap to industry, while it would mean the difference between prosperity and poverty to many power companies. The latter condition is against the interest of all consumers of power.

Liberal Attitude on Part of Industries Needed

The industrial world should adopt a new and more liberal attitude toward the power industry, should appreciate the importance of its growth and expansion and should realize what a fundamental factor it is in the development of manufacturing. If the power companies are to prosper, industry must co-operate with them and assist them in securing a fair share of industrial profits. If they do not, power companies cannot follow up the growing demands of manufacturers.

Let public service commissions devote their attention more to the distribution of earnings between interest, dividends, maintenance, surplus and amortization, than toward the limiting of earnings themselves. Many power properties are not being maintained as they should be, and too much of the expenditure on plant is now charged to capital which should be paid for out of surplus earnings as an operating expense. Only the companies which have been the most prosperous can afford to do otherwise.

Before any extensive construction of new water powers can be carried out by private corporations the general financial status of power companies must be improved. This can be brought about only by a radical revision upward in power rates. If the power consumer cannot be made to appreciate the necessity of this, then let each manufacturer provide himself with his own source of power and bring down upon himself the consequence of a policy which is so disastrous and so short-sighted.

While it seems very doubtful under prevailing conditions that the necessary capital can be attracted for new water-power enterprises, the economic conditions of the country and the constantly increasing fuel shortage demand that new water powers be developed, and developed at once, as a national necessity. As a consequence, unless such enterprises can be made attractive for the investment of private capital, the state governments or the federal government will be forced to lend credit for their development. We will then have political control and management of our water powers, together with all that signifies in inefficient management, poor service, waste, delay and more taxation.

Let us hope that the passage of the water-power bill will be followed up by an enlightened movement toward higher rates for power, so that the stagnation in the development of this most important and basic American industry can be removed.

Experience Shows Economy of Automatic Operation

IN A RECENT report on the installation and operation of two automatic railway substations it was shown that the increased cost of the equipment was wiped out in three years and one year respectively.

One of these substations was to replace a floating storage battery on the Rochester & Sodus Bay line of the New York State Railways at Williamson, N. Y., and the other the Manlius substation on the Oneida line of the West Shore electrication between Syracuse and Utica. The Manlius substation is about 5½ miles (8.8 km.) east of Syracuse and was equipped with two 300-kw. rotaries, one of which was removed and placed elsewhere on account of changed traffic conditions. Prior to the installation of the automatic equipment, this remaining machine was operated by three men working on eight-hour shifts. These two stations are of particular interest, owing to the fact that one was built especially for an automatic operation while the other is an adaptation of a manually operated substation to automatic control. The automatic equipment at Williamson eliminates the operation of the rotary 50 per cent of the time, during which it would otherwise have been operating, and at Manlius 36.5 per cent of the time. At Williamson this produces an annual saving of $236.52 in power cost and at Manlius a saving of $201.48. A table shows that it required only one and one-tenth years of operation to cancel the original cost of installing the automatic equipment.

DATA ON MANLIUS CENTER AUTOMATIC SUBSTATION

Substation operated non-automatically, hours per day.	20½
Substation operated automatically, hours per day.....	13
Saving in operating time, hours per day.....	7½
Per cent of non-automatic running time substation operates automatically.....	63.5
Cost to install automatic equipment.....	$3,400.00
Freight.....	42.00
Miscellaneous material, conduit, wire, etc.....	275.42
Total.....	$3,717.42
Labor cost.....	483.20
Total cost to install.....	$4,200.62
Annual charges:	
Fixed charges and depreciation, at 10 per cent.....	$420.06
Repairs to automatic equipment (estimated).....	100.00
Labor cost to inspect, one and one-half hours per day, at 45 cents.....	246.60
Annual yearly expense.....	$766.66
Annual gross saving:	
Labor of three men at 45 cents per hour, eight hours per day.....	$3,942.00
Relief operator seventy-eight days per year, eight hours per day, at 47½ cents per hour.....	296.40
Saving in power estimated, 7½ × 8 kw., 60 kw.-hr. per day, 21,900 kw.-hr. per year at 0.92 cents.....	201.48
Saving in coal for heating substation.....	200.00
Gross saving.....	$4,639.88
Annual charges.....	766.66
Net annual saving.....	$3,873.22
Number of years to cancel original cost.....	1.1

The Modern Trend of Hydro-Electric Engineering

Equipment of Different Periods Compared — Future Possibilities — Reasons for Tendencies Toward Use of Fewer and Larger Machines of Vertical Design, Higher Efficiencies and Individual Pipe Lines

By W. M. WHITE
Manager and Chief Engineer Hydraulic Department Allis-Chalmers Manufacturing Company

AN ANALYSIS of the trend in the use of hydro-electric machinery shows a tendency more and more toward vertical units of as large a capacity as the particular development will warrant or as can be constructed and transported. So far only a minor portion of the water powers have been developed, but it is hoped that laws will soon be passed which will induce a flow of capital to this line of public service.

Fifteen to eighteen years ago the paramount object in hydro-electric developments was to select and arrange apparatus so that continuity of operation would be maintained in each plant. This practice was necessary because the majority of the plants were isolated and thus dependent upon their own power equipment for all power delivered. As a result the standard for hydro-electric machinery for plants at that time was for not less than four units, each unit having an overload capacity of 25 per cent, so that with one unit out of service for repairs the three remaining units could maintain the service. The size of the units was fixed by this rule. The average hydro-electric plant of those days was not large, although the units were of such size as to command interest when they were first installed.

As the demand for power increased the size of the units increased, and at one period of development the manufacturers of hydraulic equipment were put to a task to develop and build machines of the size demanded by the economic considerations of each particular development. Now the size of hydraulic turbines is limited only by the ability to construct and transport the parts when not controlled by economic considerations. The intricacies of the problems involved in the design and construction of these machines have drawn a body of able, enthusiastic, clear-thinking, young engineers to the work, and consequently there has existed for some time a greater rivalry in the engineering forces of the competing companies than probably exists in any other line of similar endeavor. The competition, particularly in the engineering end, is keener than the profits in the work would justify, but the intricacies of the problems involved hold the interest of those engineers devoted to this subject.

When the machinery which has been installed in the various hydro-electric plants in the United States is considered, one is impressed with the fact that the trend has always been toward the simplification of the machinery. It is interesting to note that the early turbines installed in the middle of the last century were of the vertical type. For a time the trend was toward the horizontal design, first because of the difficulty of supporting the revolving weights when held in the vertical position and, second, in order to provide higher speeds for the generators. However, the invention of the Kingsbury bearing has switched the trend back to the vertical machines.

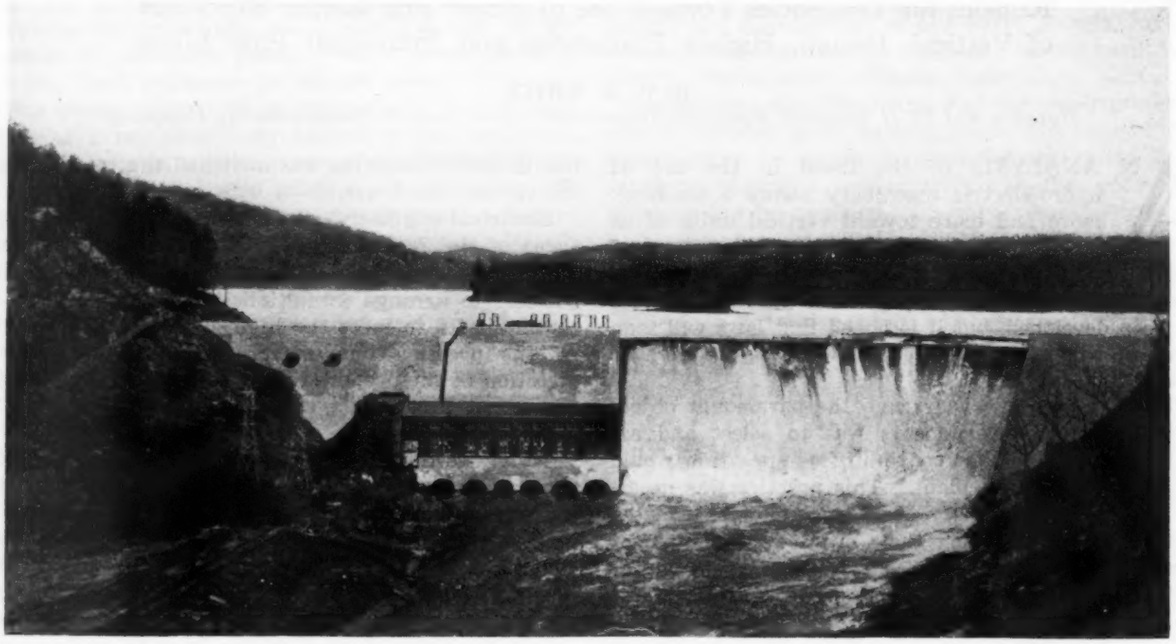
Electrical engineers' recommendations as to size and speed of the generators had a predominating influence at one time, making it necessary for the waterwheel builders to arrange a multiplicity of runners on horizontal shafts to meet the high speeds then demanded. At the present time, however, the trend is in the direction of the proper size and speed for the hydraulic equipment first and a suitable size and speed of the generators second.

To assure the highest degree of continuity of operation, many companies have installed steam reserve in the cities served, especially where the location of the hydro-electric plants has necessitated long transmission lines that might be the cause of serious interruptions. Operating companies have sought even greater factors of safety by interconnecting their lines with other companies so that energy may be exchanged in times of need. This community spirit among the operating companies is splendidly exemplified in the various companies operating in the Carolinas, Tennessee, Alabama and Georgia. The rains in these states are quick, sharp and torrential. The terrain is hilly so that the floods quickly run to the sea. That section of the country has abundant rainfall, and the hilly terrain provides a multiplicity of streams. As the rains are usually local in extent, it frequently happens that one stream may be flooding its banks while the adjacent stream is at low ebb. The power interests in that section of the country are now interconnecting and combining their operation so as to take the greatest advantage of the flood waters in any stream for the benefit of all. Thus naturally the trend of hydro-electric development is to overdevelop any given river to a greater extent than would be justified if a community of interests did not obtain. Such overdevelopment has even greater justification when one company controls many plants on several streams.

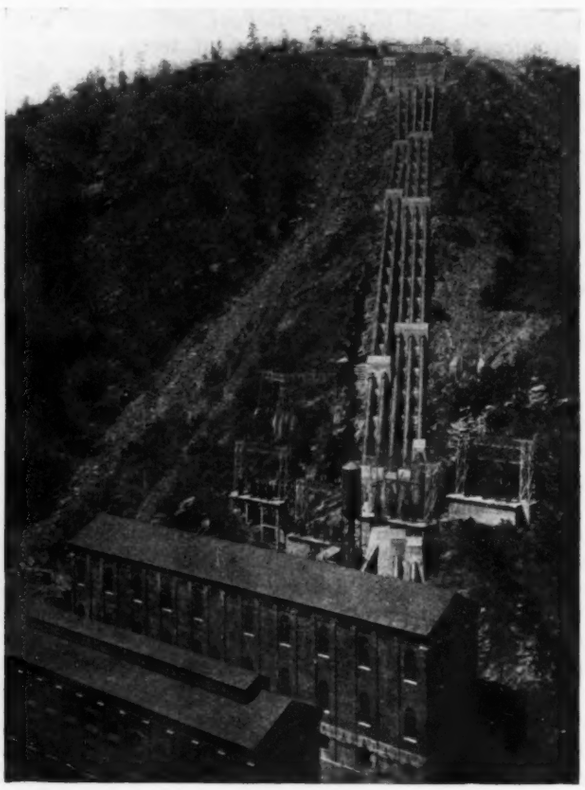
As the steam auxiliaries and interconnecting lines have increased in numbers the demand for a multiplicity of units in any hydro-electric station has decreased, and it is not necessary, except in unusual cases, to multiply the units in any given development for the purpose of maintaining service continuity and practically full-power output from that station. The modern trend, therefore, in the selection of machinery for any given development is dominated by the one thought of ultimate economy in the completed development. In several recent developments the power house contains only one hydraulic unit.

In most of the recent hydro-electric developments the turbines have been of the single-runner vertical type for the purpose of obtaining the maximum efficiency at the minimum cost. When horizontal turbines are used

Two Noted Southern Developments That Save Coal



Ocoee River plant of the Tennessee Power Company at Parkville, Tenn., that develops more than 15,000 hp. This is one of two developments on this river having a total rating of about 24,000 hp. The installation has permitted industrial development that might not have occurred otherwise. Tallulah Falls development, shown in the lower right-hand view, with a rating of 72,000 kw. was barely finished when the shortage of coal supply and the rapid increase in power demand due to the war forced the Georgia Railway & Power Company to provide additional storage for the operation of the maximum rating of this station. This company controls about 275,000 kw. in undeveloped water-power sites; 97,000 kw. in developed hydro-electric plants. The view at the left shows the falls before development of this natural power had been begun.



it is necessary to turn the water through a 90 deg. bend immediately after it has left the runner. This elbow is the cause of considerable loss. The vertical turbine, therefore, affords higher efficiency and enables keeping the water away from the electrical apparatus. The larger the river developed the larger usually the variation in the tailwater level, so that the vertical units provide for keeping the generator above flood elevation.

In the older developments of small-sized units one pipe line was generally used, with branch pipe lines to each of the units. The modern tendency, however, is to have a separate pipe line to each of the turbines. When the pipe line is of considerable length, butterfly or needle valves are usually installed in or near the power house so that immediate control is had of the water to the units. Where the pipe lines are short and up to a length of approximately twice the operating head the tendency is to install headgates at the forebay for the control of the water to the unit. On developments where the usual riveted plate-steel penstock is used the tendency is to terminate the penstock in a spiral plate-steel casing in line with the practice of constructing concrete spiral casings when the head is sufficiently low to make it possible to take care of stresses in the concrete.

The larger vertical turbines are designed with as high a speed as is practicable for the head under which the desired power is to be developed. There are limitations, however, to the speed which can be used with safety, and certain definite empirical formulas have been developed on these limitations. The diameter of a runner is fixed by the speed and head and varies inversely as the speed; consequently when the diameter is very small such a high discharge velocity may result that it will consume considerable energy. This is now one of the major losses in hydraulic turbines. A considerable portion of the discharge loss can be eliminated by the use of a "hydraucone regainer" which was developed as a result of a series of experiments conducted about five years ago. There is feverish activity along this line of development just now, and it is evident that the greatest improvements in hydraulic turbine efficiency is to come from the utilization of that form of draft tube which will regain the greatest energy from the water discharge from the turbine. It is expected that considerable rivalry and contention concerning this line of development will exist for some time to come.

One of the difficult problems in hydro-electric plants heretofore has been the governing apparatus, but the leading hydraulic turbine builders have developed governors which are now effective, positive in action, and uniform in performance. Directly connected flyballs mounted upon the main turbine shaft have been used on several large units recently with good results. It is predicted that the trend of governor design for hydraulic turbines will be toward directly connected flyballs and the incorporation of the valves and control mechanism nearer the turbine and possibly within the turbine pit, instead of installing them on the main generator floor as has been done heretofore.

The greater use of long tunnels driven into solid rock is an evidence of the trend toward permanent construction and is an attempt to eliminate all possible operating expenses.

The efficiency of hydraulic installations has steadily increased, so that it is possible now on the larger plants to secure 90 per cent efficiency between the water delivered to the power house and the switchboard.

The elaborate oiling systems which have heretofore been used in connection with the thrust bearings in supporting the weights of the revolving parts are no longer essential. This is evidenced by recent experiments, and it is predicted that the smaller plants will hereafter use air-cooled bearings and the larger ones water-cooled bearings without any circulation of oil outside the bearing housing itself.

In considering large, high-head developments it has been the plan recently to balance the estimated cost of the development in one plant against the development of the stream by several plants. The latter scheme has the advantage of keeping down the overhead charges when only a portion of the power resulting from the complete development of the stream could be used at once.

Some good results have already been achieved by automatic hydro-electric stations, and it is thought that considerable activity will take place in the future on this type of plant. These plants usually require induction or asynchronous generators, although synchronous generators have been installed in one recent hydro-electric plant which is controlled and operated automatically from a distant point. Recent inquiries for automatic governors for the control of these automatic plants illustrate the trend of thought among engineers in this direction, and a recent invention relating to governors for these plants may have some influence on this type of development.

Keeping Up Steam in Idle Boilers Takes Over 0.02 Gal. of Oil per Hp.-Hr.

KEEPING boilers fired in readiness to carry load requires 0.00653 gal. to 0.02248 gal. (0.025 l. to 0.085 l.) of oil per rated boiler-horsepower-hour, according to records of three Pacific Coast companies. The lower figure is for a 1,000-hp. plant, the second figure is for a 15,000-hp. plant, while a third plant of 12,000 hp. in boilers consumed 0.02204 gal. (0.0833 l.)

FUEL OIL CONSUMED TO KEEP BOILERS HOT

Station	Days	Consumed Oil (Gal.)	Boiler Hp.-Hr.	Oil Consumed per Boiler, Hp.-Hr.(Gal.)
1	14	2,470	37,816	0.00653
2	24	50,482	2,201,350	0.02204
3	50	34,293	1,524,000	*0.02248
3	55	18,112	1,027,450	†0.01762
3	105	52,405	2,549,450	‡0.02053

* No machines running during these days.
† Machines running part of day.
‡ Mean of above.

of oil per boiler-horsepower-hour when boilers were carrying steam but were idle.

This expense is only a part of the cost of being ready to serve at any time. Other items entering into the total cost of this service are interest on the investment, depreciation of apparatus and actual operating expense during the standby period. Under this last item, besides labor, repairs and supplies, is the fuel cost, of which the foregoing are examples. Added together, these expenses amount to a good share of a company's total expense.

Water Powers of the United States

Analysis of Developed and Undeveloped Sources Made by the "Electrical World" Indicates that the Total Potential Water Power Is 59,360,000 Hp., of Which Only 9,823,540 Hp. Is Developed

THE amount of developed and undeveloped water power in the United States should be of utmost interest to the electrical industry at the present time in view of the crying demand for more power, the necessity of conserving fuel, the importance of relieving railroads of fuel transportation, and especially because of the probable early passage of the water-power bill. To answer some of the questions which may arise the ELECTRICAL WORLD has made a survey from which it has estimated as closely as possible the potential, developed and undeveloped water powers of the country as well as the probable energy market in 1930. This analysis has been based on data obtained from the Surface Water Resources Branch and Land Classification Board (United States Geological Survey), Commissioner of Corporations, Forest Service (Department of Agriculture), Census Bureau (Department of Commerce), Dr. Charles P. Steinmetz's and Philip Torchio's analyses, and data obtained by the statistical department of the ELECTRICAL WORLD.

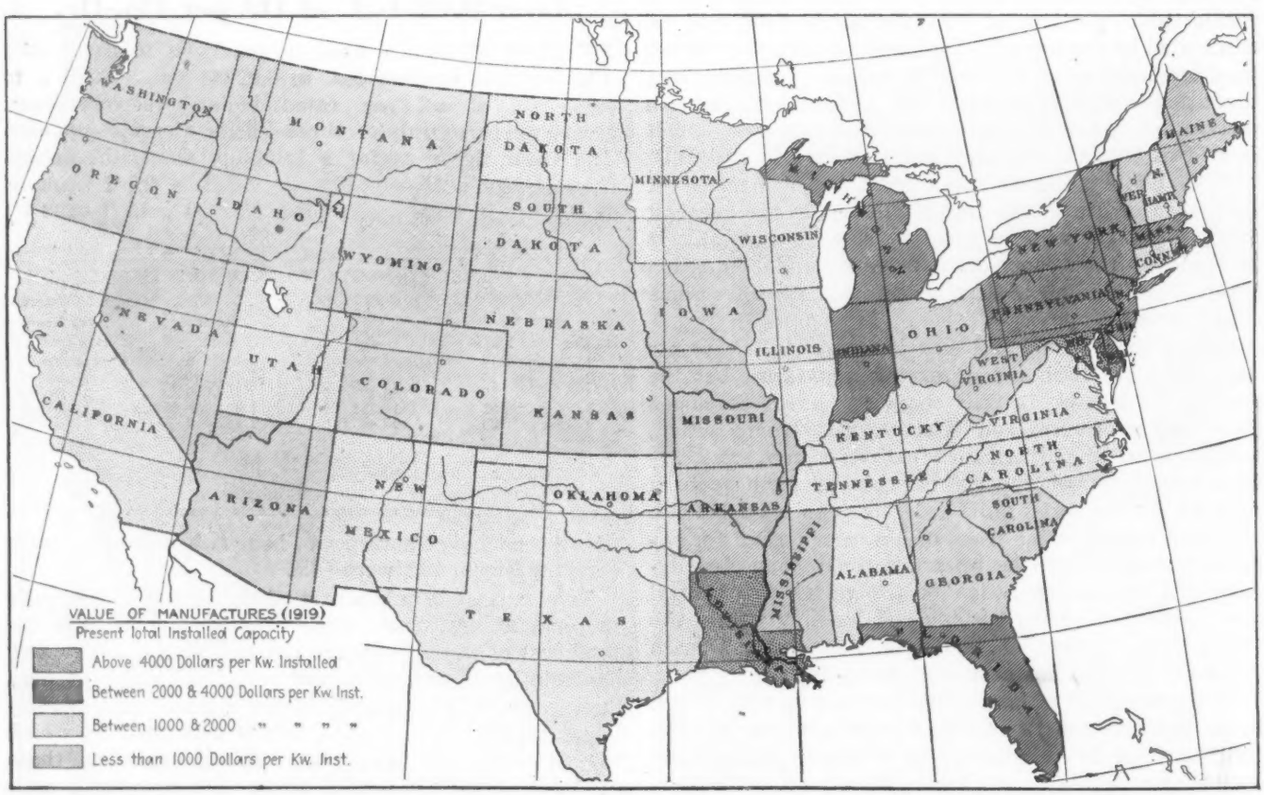
The Census Bureau made estimates on developed water powers in 1902, 1907, 1912 and 1917. However, the full 1917 report has not been issued to date, and the latest detail data of all states from this source is the 1912 census. Herman Stabler, chief engineer of the Land Classification Board, United States Geological Survey, has recently made an estimate of the developed water powers of the United States segregated into central station and electric railway installations and isolated plants of all kinds. The figures of this estimate appear below. They are based on the various census reports on central stations and electric railways, census data for manufactures, mines and quarries, and all available data on the innumerable small water-power plants which are accessible only to an engineer in Mr. Stabler's position.

TABLE I—INSTALLED CAPACITY OF WATERWHEELS IN THE UNITED STATES IN TENS OF THOUSANDS OF HORSEPOWER

Year	Central Stations and Electric Railways	Isolated Plants of All Kinds, Including Manufactures, Mines, Quarries, Federal and State Institutions, Etc.	Total
1902	*49	319	368
1903	63	325	388
1904	79	334	413
1905	98	342	440
1906	120	349	469
1907	*144	357	501
1908	170	366	**536
1909	198	371	569
1910	228	372	600
1911	260	372	632
1912	*294	372	666
1913	330	372	702
1914	367	373	740
1915	406	373	779
1916	446	373	819
1917	*488	373	861
1918	530	374	904
1919	573	374	947
1920	617	374	991
1921	661	374	1,035
1922	706	374	1,080

* U. S. Census Figures.

The above figures for isolated plants appear nearly constant over a period of years. This does not mean, however, that there were no new private installations



654 FIG. 1—COMPARISON OF INDUSTRIAL POWER DEMAND WITH TOTAL GENERATING CAPACITY OF POWER PLANTS OF ALL KINDS

during these periods, but that some of them have become central stations and have been transferred to the central station and electric railways column. Instances of this are the Green Creek plant, near Bodie, Cal.; plants of the Ophir Hill Consolidated Mining Company, Utah; New England Power Company plant No. 3, and the plant of the Reclamation Service on Boise River, Idaho.

A study of the installations of central stations of the country given in the "McGraw Central Station Directory and Data Book," 1919 edition, affords a basis upon which to estimate the total developed water powers of the country by states, using the 1920 Stabler estimate given in the above table. For instance, on Jan. 1, 1919, the waterwheels installed in North Carolina central stations totaled 144,405 hp., and the total installed waterwheels of the central stations in the United States were rated at 4,493,569 hp. The waterwheels of the central stations of North Carolina, therefore, were 3.2 per cent of the total for the country. Assuming that this ratio will hold for isolated plants for 1920 of 3,740,000 hp., a total of 316,000 hp. is obtained as the installed water capacity of all kinds of electric power plants in North Carolina. In a few instances this method of computation will possibly not hold, and corrections were found necessary based upon state and private reports. The estimate for the state of New York is that given by the State Conservation Commission in its 1919 report.

The United States Geological Survey made the first comprehensive estimate of the undeveloped water powers of the country in 1908. This report, however, did not include estimates for individual states but was based on drainage areas as the unit. A later estimate, made in 1915, was segregated by states. Other estimates of the undeveloped water powers were made by the Commissioner of Corporations in 1912 and by the Forest Service in 1916. All three of these reports also include estimates of the developed water powers, the Forest Service estimate, however, being the same as the 1912 census figures. The above estimates will be found in detail in the table on page 658. Since 1916 no detailed estimate has been published of either developed or undeveloped water powers, with the exception of a few separate state reports by the Census Bureau, based on the 1917 census, and three or four state conservation reports.

Estimates of the potential water powers of the country as a whole have been made by several prominent engineers. Probably the most technical investigation of this question was undertaken by Dr. Charles P. Steinmetz, chief consulting engineer, General Electric Company. His analysis was presented in a paper read before the annual convention of the American Institute of Electrical Engineers at Atlantic City, June, 1918. From a consideration of rainfall and topography Dr. Steinmetz estimates "950,000,000 kilowatt-years (twenty-four-hour service) as the total potential water powers in the United States, or the hydraulic energy of the total rainfall from the elevation where it fell, down to the sea level. An approximate estimate, after a minimum allowance for agriculture and losses, gives the maximum available potential energy from rainfall at about 380,000,000 kw. (twenty-four-hour service) or 230,000,000 kw. (twenty-four-hour service) at 60 per cent efficiency." Obviously only a portion of this power will ever be developed.

Another estimate based on the number of heat units produced by the coal consumed in the country was presented before the National Electric Light Association in 1915 by Philip Torchio, chief electrical engineer, New York Edison Company, and before the A. I. E. E. just recently. Mr. Torchio states that the 542,000,000 tons† of coal produce a total energy, figured in terms of British thermal units, of 3,908,320,000

†Consumed in 1915.

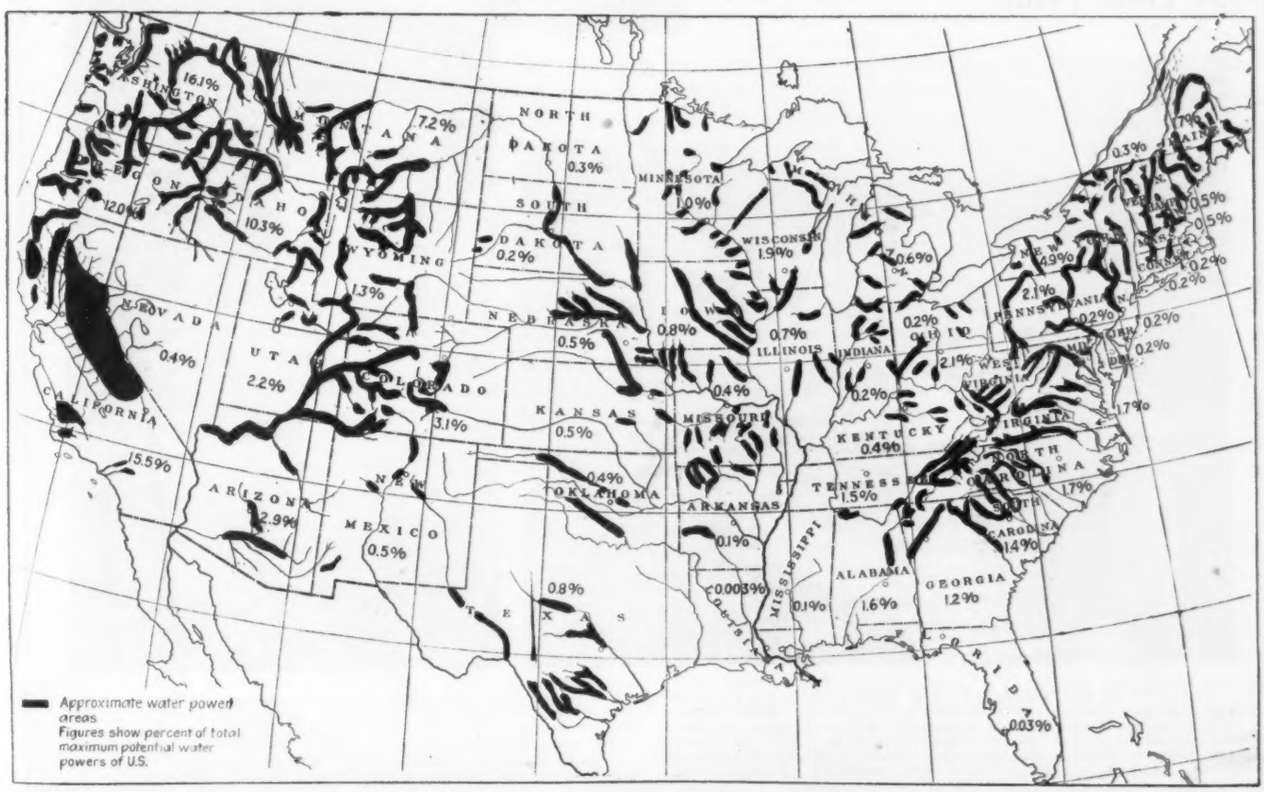
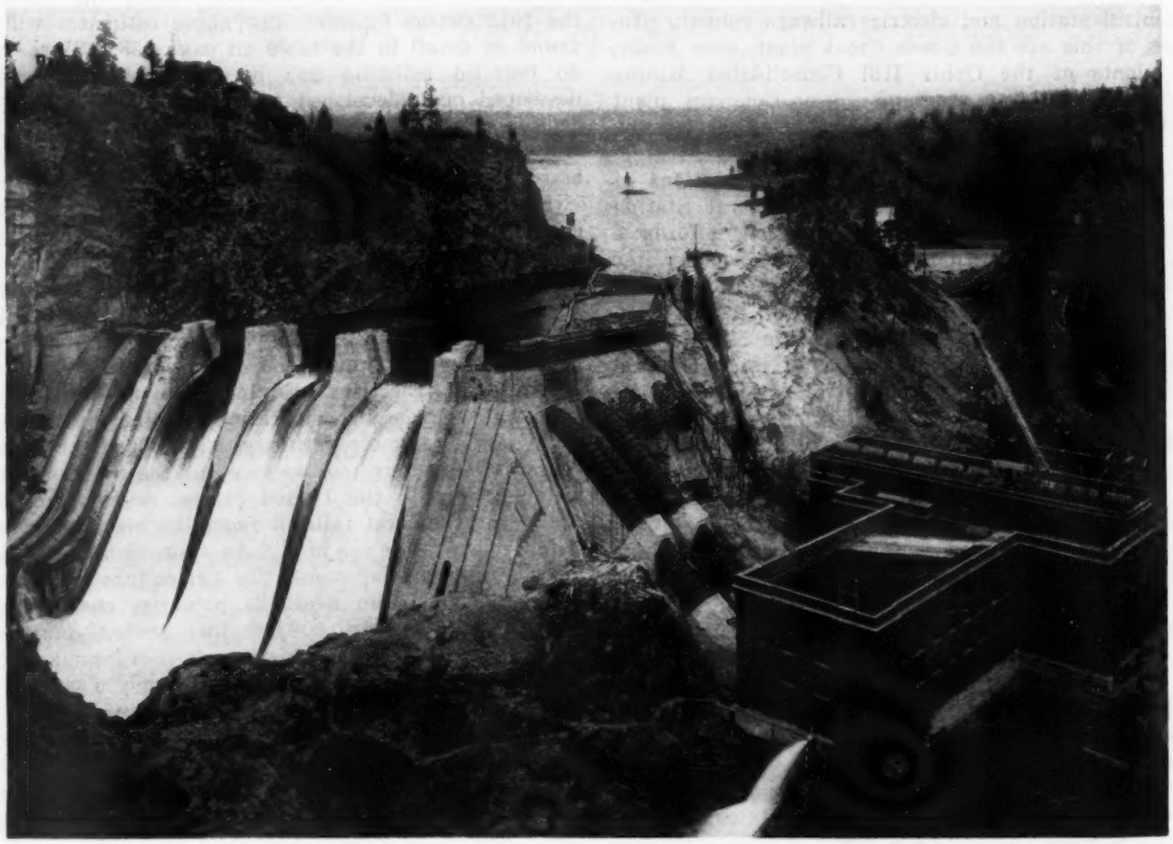
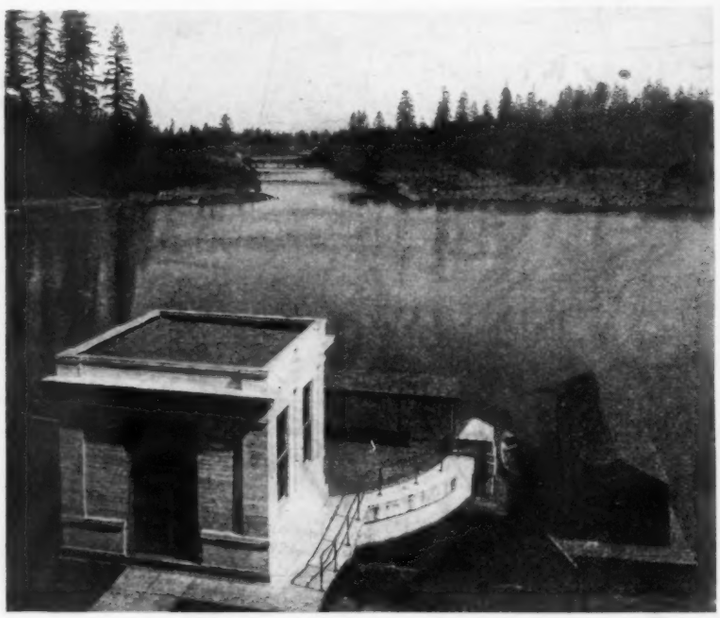


FIG. 2—IMPORTANT POTENTIAL WATER POWERS OF THE UNITED STATES AND THE PERCENTAGE OF TOTAL IN EACH STATE



Electrification of the C., M. & St. Paul Railroad Was Made Possible by These Plants



The view at the top shows Long Lake station on the Spokane River, Wash., the principal hydro-electric plant of the Washington Water Power Company, whose system is interconnected with the Puget Sound Traction, Light & Power Company to furnish motive power for the Chicago, Milwaukee & St. Paul Railroad, giving a total backing of 300,000 hp. on the east and west sides of the Cascades. Below (at left) is the tunnel intake of the White River power plant of the Puget Sound company. The canal in back ground connects with huge storage reservoir. The illustration at the right shows Snoqualmie Falls which furnishes a head of 268 ft. for an underground station of the Puget Sound Company.

units, 121,620,000 units in the Western States and 3,786,700,000 units in all other states. If all the water powers of the country were utilized, they could replace 1,046,000,000, or 27 per cent, of the above units. Of this, 746,000,000 units, or 614 per cent of total energy used, are available in the Western States and 300,000,000, or 8 per cent of total energy used, in all other states. The water powers already developed represent 73,900,000 units, of which 22,900,000, or 19 per cent of the total energy used, are in the Western States, and 51,000,000, or 1.4 per cent of total energy used, in all other states. The Western States possess large water-power resources sufficient to furnish several times their total power and heat requirements, but all other states are inadequately supplied with water powers.

Estimates of potential water power vary according to the basis upon which they are made. As indicated above, Dr. Steinmetz took into consideration only the rainfall and topography. The United States Geological Survey, the government authority on surface-water computations, bases water-power estimates upon three assumptions: (1) the power which may be produced by a minimum flow, (2) the assumed maximum development, and (3) the additional power that may be recovered by developing the available storage capacity in the upland basins and using stored water to compensate the low-water periods. In determining the minimum development the flow for the lowest two consecutive seven-day periods in each year is determined and the mean of these values for the period of record is taken as a minimum flow. The maximum development is that amount the continuance of which can be assured during six months of the year. The figures given in the table on page 658 are based upon assumptions 1 and 2.

In the investigation to ascertain the potential water powers of the country the ELECTRICAL WORLD has used as a basis the 1915 estimates of the United States Geological Survey. A careful study has been made of water-power reports issued by engineers of the Geological Survey since 1915, reports of other Federal departments, State conservation and surface-water reports, as well as private engineering reports. Corrections to the Geological Survey estimates of 1915 have been made based upon these various reports.

The maximum potential water powers of the United States are estimated by the ELECTRICAL WORLD to total 59,360,000 hp. at 90 per cent efficiency. Of this amount 9,823,540 hp., or 16.6 per cent, has been developed, leaving 49,536,460 hp. still undeveloped. No estimates of the power possibilities with storage are believed practicable in view of the limited data available. An estimate of 200,000,000 or more horsepower as the possible water horsepower with maximum storage was made by the United States Geological Survey in 1908, but later computations by that bureau have led to the belief that this figure is somewhat too large.

The Pacific States lead in potential water power, while the Atlantic States show the largest amount of development. Washington leads the states in potential water powers, and New York heads the list in water powers developed, being followed closely by California. The estimates by states and sections will be found in detail in the table on page 658. Fig. 3 shows the potential, developed and undeveloped water powers of the country by sections.

It should be remembered, in comparing estimates of undeveloped water powers with figures for developed powers, that the former are usually given in terms of continuous or twenty-four-hour horsepower, while the developed horsepower is stated as the installed capacity, which is developed in many instances only during a portion of each day—in the case of power for a manufacturing plant about ten hours per day. Moreover, most estimates of undeveloped power are based on minimum stream flow, while estimates of developed horsepower, including those given in the United States census reports, are the combined capacity of the plants. The error in comparing such figures is apparent. For instance, the McCall's Ferry hydro-electric plant on the Susquehanna River has an installed capacity of 108,000 hp., while the capacity of this site based upon minimum stream flow is only about 15,000 hp. It will be found in most instances that figures given for the maximum development of a power site are more comparable with figures for developed water powers than are those for low-water possibilities. With the incomplete data available any estimate of this nature cannot be regarded

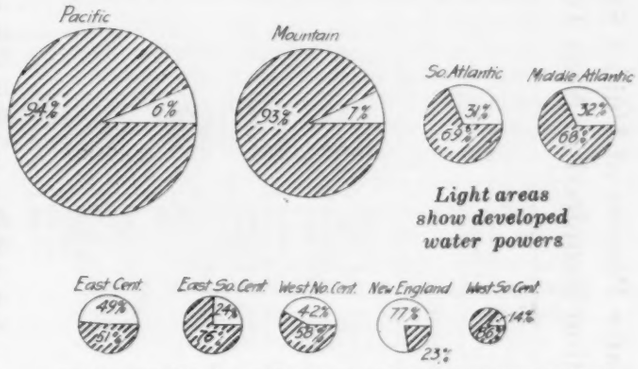


FIG. 3—POTENTIAL, DEVELOPED AND UNDEVELOPED WATER POWERS OF THE UNITED STATES BY SECTIONS

as accurate and should be used with discrimination and always with the understanding that the figures are rough approximations.

An attempt has been made to estimate the probable energy market in 1930 which cannot be accommodated by the present installed capacity of the electrical generating plants of the country. In making this estimate it has been considered that the demand may take the form of (1) more energy needed to supply the present industries using electricity as a prime mover, (2) a demand for energy by an entirely new industry, or (3) the replacing of present forms of prime movers by electric drive. The present ratio between the value of manufactures (which is a measure of the industrial power demand) and the total installed horse power of generating plants of all kinds is indicated by Fig. 2. A comparison of this map with Fig. 1 will indicate the present probable high or low energy market calling for increased hydro-electric or steam installation in each state.

The figures in the last column of the table on page 658 give the additional installations which it is believed must be installed in the next ten years to supply properly the market for electrical energy in 1930. In making this estimate the 1914 census of manufactures and primary power used in manufacturing establishments has been used as a basis. To obtain the total installed generator rating in 1914 a study has been made of the central-station installation as given in the 1914 edition of the "McGraw Central Station Directory and Data Book," and the results have been used in connection with

Potential, Developed and Undeveloped Water Powers of United States, and Estimate of Increased Generator Installation Required in Next Ten Years

State	Commissioner of Corporations Estimate of 1912				U. S. Forest Service Estimate of 1912				U. S. Geological Survey Estimate of 1915			"Electrical World" Estimate, January 1, 1920					
	Potential		Developed		Potential		Developed		Potential	Developed		Potential	Developed		Undeveloped	Growth	
	Minimum	Maximum	Horse-power	Per Cent of Maximum	Minimum	Maximum	Horse-power	Per Cent of Maximum	Maximum	Horse-power	Per Cent of Maximum	Maximum	Horse-power	Per Cent of Maximum	Maximum	Hp. Required in 1930 in Excess of Present Station Ratings	% of Total Station Ratings
New England States	1,042,000	1,925,000	631,165	33.0	868,000	1,605,000	1,059,810	66.2	1,921,000	1,441,000	75.0	1,951,000	1,506,500	77.2	444,500	1,113,000	23.7
Atlantic States	4,441,000	8,092,000	1,392,083	17.2	3,703,000	6,745,000	1,721,696	25.5	10,922,000	3,019,000	27.7	9,348,000	2,952,850	31.6	6,395,150	5,633,000	47.8
Central States	3,805,000	7,612,000	816,823	10.7	3,174,000	6,346,000	836,909	13.2	7,797,000	1,589,000	20.4	7,360,000	2,699,200	36.7	4,660,800	6,067,000	42.1
Mountain States	8,991,000	16,356,000	344,000	2.1	8,694,000	16,131,000	359,884	2.2	17,100,000	800,000	4.7	14,851,000	1,113,990	7.5	13,737,010	70,000	3.7
Pacific States	13,804,000	27,693,000	831,754	3.0	11,504,000	23,078,000	888,810	3.9	25,750,000	1,760,000	6.8	25,850,000	1,551,000	6.6	24,299,000	470,000	19.0
Total United States	32,083,000	61,678,000	4,016,127	6.5	27,943,000	53,905,000	4,867,109	9.1	63,490,000	8,609,000	12.7	59,360,000	9,823,540	16.6	49,536,460	13,353,000	37.9
Alabama	611,000	1,132,000	16,450	1.5	509,000	943,000	26,446	2.8	1,130,000	170,000	15.1	943,000	180,000	19.1	763,000	67,000	15.5
Arizona	1,071,000	2,038,000	16,200	0.8	893,000	1,698,000	9,346	0.6	2,000,000	34,000	1.7	1,698,000	67,600	4.0	1,630,400	55,000	40.4
Arkansas	26,000	73,000	.....	.....	22,000	61,000	3,768	6.2	75,000	12,000	16.0	75,000	13,400	17.9	61,600	7,000	5.0
California	4,109,000	9,382,000	435,467	4.6	3,424,000	7,818,000	440,243	5.6	9,250,000	910,000	9.8	9,250,000	942,000	10.2	8,308,000	314,000	19.7
Colorado	1,010,000	2,036,000	69,690	3.4	842,000	1,697,000	83,230	4.9	2,000,000	190,000	9.5	1,850,000	238,000	12.8	1,612,000	.....	.....
Connecticut	86,000	164,000	47,519	28.9	72,000	137,000	98,544	71.8	165,000	130,000	78.8	165,000	161,800	97.7	3,200	26,000	2.1
Delaware	6,000	13,000	.....	.....	5,000	11,000	5,970	54.3	13,000	9,000	69.3	13,000	9,000	69.3	4,000	28,000	46.7
District of Columbia	6,000	13,000	.....	.....	4,920	10,530	1,000	9.5	13,000	1,000	7.7	13,000	1,000	7.7	12,000	12,000	8.6
Florida	9,000	16,000	5,000	31.3	8,000	13,000	7,303	56.2	16,000	16,000	100.0	16,000	16,000	100.0	.....	.....	.....
Georgia	449,000	752,000	139,277	18.5	374,000	627,000	111,501	17.7	750,000	250,000	33.4	750,000	420,000	56.0	330,000	95,000	13.7
Idaho	1,394,000	3,080,000	52,100	1.7	2,362,000	5,067,000	55,054	1.1	6,000,000	160,000	2.7	6,110,000	89,400	1.5	6,020,600	.....	.....
Illinois	230,000	414,000	51,211	12.4	192,000	345,000	53,850	15.6	410,000	110,000	26.9	410,000	191,000	46.7	219,000	1,302,000	41.2
Indiana	52,000	141,000	14,675	10.4	43,000	118,000	30,733	26.1	140,000	38,000	27.2	140,000	183,000	130.0	.....	558,000	46.3
Iowa	192,000	458,000	151,400	33.0	160,000	382,000	13,368	3.5	450,000	23,000	5.6	450,000	423,000	94.2	27,000	78,000	10.4
Kansas	133,000	323,000	6,800	2.1	111,000	269,000	17,223	6.4	320,000	21,000	6.6	320,000	105,000	32.8	215,000	7,000	1.1
Kentucky	99,000	236,00	.....	.....	83,000	197,000	5,841	3.0	250,000	15,000	6.0	250,000	61,400	24.6	188,600	62,000	16.8
Louisiana	1,000	2,000	.....	.....	1,000	2,000	.....	.....	2,000	1,000	50.0	2,000	1,000	50.0	1,000	94,000	25.4
Maine	532,000	971,000	233,698	24.0	443,000	809,000	387,073	47.8	970,000	520,000	53.7	1,000,000	780,000	78.0	220,000	.....	.....
Maryland	51,000	146,000	5,376	3.7	43,080	122,470	12,651	10.4	145,000	27,000	18.6	145,000	5,500	3.8	139,500	308,000	110.0
Massachusetts	142,000	273,000	130,619	47.8	118,000	228,000	214,558	93.8	275,000	280,000	102.0	275,000	268,000	97.5	7,000	900,000	54.2
Michigan	216,000	352,000	133,102	37.9	180,000	293,000	178,079	60.8	350,000	310,000	88.7	350,000	357,000	102.0	.....	1,535,000	127.0
Minnesota	278,000	593,000	168,015	28.3	232,000	494,000	174,537	35.4	600,000	220,000	36.7	600,000	233,000	38.8	367,000	261,000	43.2
Mississippi	38,000	75,000	.....	.....	32,000	63,000	335	0.5	75,000	8,000	10.7	75,000	10,600	14.1	64,400	6,000	5.9
Missouri	86,000	195,000	1,344	0.7	72,000	163,000	5,647	3.5	200,000	10,000	5.0	200,000	39,500	19.8	160,500	49,000	6.9
Montana	3,299,000	5,197,000	139,260	0.3	2,749,000	4,331,000	119,300	2.8	4,500,000	250,000	5.6	4,250,000	395,000	9.4	3,855,000	.....	.....
Nebraska	235,000	439,000	.....	.....	196,000	366,000	13,449	3.7	430,000	19,000	4.4	280,000	65,200	23.3	214,800	.....	.....
Nevada	206,000	331,000	14,200	4.3	172,000	276,000	12,709	4.5	250,000	33,000	13.2	250,000	55,500	22.2	194,500	4,000	6.4
New Hampshire	162,000	295,000	120,108	40.7	135,000	246,000	203,772	82.7	295,000	280,000	95.0	295,000	76,000	25.8	219,000	94,000	42.0
New Jersey	53,000	127,000	7,200	5.7	44,000	106,000	22,132	20.9	125,000	40,000	32.0	125,000	44,830	35.8	80,170	1,052,000	50.3
New Mexico	192,000	527,000	.....	.....	160,000	439,000	864	0.2	300,000	3,000	1.0	320,000	650	0.2	319,350	.....	.....
New York	1,244,000	2,037,000	713,371	35.1	1,037,000	1,698,000	896,229	52.8	4,500,000	1,320,000	29.4	2,926,000	981,520	33.5	1,944,480	2,410,000	83.4
North Carolina	693,000	1,050,000	97,010	9.2	578,000	875,000	110,203	12.6	1,000,000	280,000	28.0	1,000,000	316,000	31.6	684,000	219,000	50.0
North Dakota	105,000	248,000	.....	.....	88,000	207,000	655	0.3	250,000	1,000	0.4	150,000	1,000	0.7	149,000	10,000	25.0
Ohio	71,000	213,000	4,025	1.9	59,000	178,000	25,572	14.3	215,000	51,000	23.7	215,000	200,000	93.0	15,000	1,150,000	85.8
Oklahoma	90,000	250,000	.....	.....	75,000	208,000	2,825	1.3	250,000	8,000	3.2	250,000	25,700	10.3	224,300	290,000	123.0
Oregon	3,777,000	7,935,000	95,777	1.2	3,148,000	6,613,000	168,807	2.6	7,000,000	280,000	4.0	7,100,000	248,000	3.5	6,852,000	54,000	13.7
Pennsylvania	331,000	821,000	169,632	20.6	276,000	684,000	190,956	27.5	1,250,000	500,000	40.0	1,250,000	359,000	28.7	891,000	1,334,000	41.2
Rhode Island	7,000	16,000	5,376	33.6	6,000	13,000	35,169	270.0	16,000	41,000	256.5	16,000	12,700	79.5	3,300	93,000	26.7
South Carolina	552,000	812,000	182,497	22.5	460,000	677,000	221,492	32.6	810,000	310,000	38.3	810,000	459,000	56.7	351,000	36,000	6.4
South Dakota	51,000	90,000	5,000	5.6	43,000	75,000	7,774	10.4	90,000	21,000	23.4	90,000	11,900	13.2	78,100	.....	.....
Tennessee	555,000	913,000	62,000	6.8	463,000	761,000	37,396	4.9	910,000	150,000	16.5	910,000	286,000	31.4	624,000	46,000	7.9
Texas	306,000	661,000	.....	.....	255,000	551,000	5,156	0.9	500,000	11,000	2.2	500,000	74,500	14.9	425,500	235,000	19.1
Utah	892,000	1,581,000	52,700	3.3	743,000	1,318,000	77,532	5.9	1,250,000	125,000	10.0	1,320,000	263,000	19.9	1,057,000	12,000	3.1
Vermont	113,000	206,000	93,845	45.6	94,000	172,000	120,684	70.2	200,000	190,000	95.0	200,000	208,000	104.0	.....	.....	.....
Virginia	590,000	1,044,000	51,320	4.9	492,000	870,000	123,079	14.1	1,040,000	210,000	20.2	1,040,000	201,000	19.5	839,000	77,000	8.1
Washington	5,918,000	10,376,000	300,510	2.9	4,932,000	8,647,000	279,760	3.2	9,500,000	570,000	6.0	9,500,000	361,000	3.8	9,139,000	102,000	21.3
West Virginia	457,080	1,261,000	21,400	1.7	381,000	1,051,000	19,181	1.8	1,260,000	30,000	2.4	1,260,000	140,000	11.1	1,120,000	73,000	18.2
Wisconsin	430,000	804,000	202,952	25.3	358,000	670,000	234,255	35.0	1,150,000	390,000	33.9	1,150,000	237,000	20.8	913,000	298,000	34.9
Wyoming	927,000	1,566,000	.....	.....	773,000	1,305,000	1,849	0.1	800,000	5,000	0.6	750,000	4,840	0.6	745,160	.....	.....

the Stabler waterwheel estimate of isolated plants in 1914. The total rating of central-station generators installed in 1914 was 9,380,000 hp., of which 3,120,000 hp., or 33.3 per cent, was waterwheels. The Stabler estimate of the total installation of waterwheels in isolated plants in 1914 was 3,730,000 hp. Assuming that the same relation will hold in isolated plants as in central stations between total installation and waterwheels, it is found that the total electrical installation of isolated plants was 11,200,000 hp. The 1914 census states that 3,917,655 hp. of generator rating in central stations was employed for industrial service; therefore the manufacturing establishments of the country called for a total generator rating in 1914 of 15,117,655 hp. The value of manufactured products in the United States in 1914 was $24,246,000,000; therefore the value of manufactured products per installed horsepower of generators was $1,602. The value of manufactured products in 1930 was computed for each state, based on the 1914 census, assuming that the rate of increase for each five years between 1914 and 1930 will be the same as between 1909 and 1914. Dividing these quantities by 1,602, the value of manufactured products per installed generating horsepower, gives the total installed generator rating which will be required in 1930 in each state. Subtracting from these computed state totals for 1930 the estimated state totals of 1920 gives the increase in generator rating (in horsepower) required between 1920 and 1930 to supply the increased energy market. This estimate indicates the increased generator rating required for manufacturing plants only and does not include that needed to supply energy for illuminating and electric railway purposes.

TABLE II—DEVELOPMENTS CONTEMPLATED ON NAVIGABLE STREAMS

State	River	Horsepower To Be Developed	State	River	Horsepower To Be Developed
Washington	Columbia	410,000	Tennessee	Clinch	25,000
Washington	Pend Oreille	250,000	Alabama	Coosa	180,000
Montana	Missouri	100,000	Kentucky	Cumberland	26,000
Minnesota	St. Croix	30,000	Georgia	Flint	20,000
Iowa	Des Moines	60,000	N. Carolina	Little Tenn.	200,000
Maryland	Susquehanna	110,000			
Mass.-Conn.	Connecticut	30,000	Virginia	New	20,000
Georgia	Chattahoochee	138,000	Virginia	Roanoke	35,000
Alabama	Tennessee	410,000	S. C.-Ga.	Savannah	78,000
Total					2,122,000

LACK OF WATER-POWER LEGISLATION A SERIOUS HANDICAP

The correctness of the assumed increases in manufactures will depend to a large extent on the money market of the next two or three years. The present scarcity of money and the high returns demanded by the investing public perhaps make the assumption questionable at this time, but it is believed that industrial and financial conditions will improve sufficiently during the next ten years to warrant it for that period. The proportion of this electrical energy market which will be supplied by hydro-electric plants is, of course, problematical, but the passage of water-power legislation by Congress and helpful state legislation will do much toward increasing this proportion.

The result of lack of proper legislation has been to hold back hydro-electric development on navigable streams. To show the extent to which such development has been retarded because of restrictive laws it is merely necessary to cite a list of developments contemplated on navigable streams alone, not including the boundary streams.

It is estimated that, in addition to that shown in Table 2, the development of more than 2,000,000 hp. would be undertaken upon non-navigable streams in California, Idaho, Oregon, Nevada, Montana, Utah, Colorado and Arkansas.

SURFACE WATERS CONTROL FUTURE OF AMERICAN INDUSTRY

The future of American industry is to a large extent bound up in the surface waters of the nation. Still, as shown by this survey, the inexhaustible "white-coal" supply which exists in every state in the Union, is now being brought into service for the convenience of humanity only to a small extent. While water power can supply only 10 per cent of the demand in the East, it is unfortunate that conditions have not been considered favorable to greater water-power development since operation of steam plants not only involves the uncertain labor factor and the difficulties of obtaining the necessary fuel supply, but, in addition, the fuel supply is becoming exhausted and must be conserved more and more as time passes. Nature has provided a source of mechanical energy which is inexhaustible and which is independent of the industrial eruptions which periodically take place throughout the country. The restrictive laws are being removed by Congress, and new energy markets are being created daily. The total estimate of the increased electrical energy market by 1930 is believed to be conservative. Whether a large proportion of this future market will be supplied by hydro-electric energy will depend to a very large extent on the regulations adopted by the federal and state governments, as well as on the general interest taken in this branch of the electrical industry by the investing public.

Comparative Economy of Oil-Burning Equipment

THE relative economy of coal and oil-burning equipment depends greatly upon the cost and availability of the two fuels. For the determination of the comparative economy a simple formula has been stated which says that when the cost of oil in cents per gallon is one-half the cost of coal in dollars per long ton the cost of generating a given amount of power is about the same for the two kinds of fuel. This does not take into account the differences in labor in the two cases, which will be more favorable to oil. With this rule it is assumed that oil has 18,600 B.t.u. per pound and the coal contains 14,300 B.t.u. per pound.

Where the load factor is low, oil will undoubtedly be preferable as a fuel to coal, provided that the supply of oil is adequate. On the other hand, where the power factor is high the use of coal is most likely to be more economical. While it is very difficult to assign fixed values to such comparisons, a load factor of about 50 per cent seems to be the dividing line above which coal will probably show an advantage, and below which oil will probably be preferable from the economic standpoint.

According to the statements made by E. H. Peabody of the Babcock & Wilcox Company before a recent meeting, it has been found from experience that the best method of atomizing fuel oil is with steam, which method is the most economical.

AEROPLANE VIEW OF NIAGARA RIVER AT THE FALLS

From Niagara River only 26 per cent of the total flow is diverted for generating electricity. Sixty per cent might be diverted without marring the scenic beauty of the falls. There is practically no variation in the flow of this river throughout the year, making it ideal for hydro-electric development. Millions of horsepower are now going to waste here merely to satisfy sentiment. A treaty with Great Britain limits the amount that can be developed now.

Power Development at Niagara Falls

Economic Importance of Niagara Falls in the Development of the Electro-Chemical Industries of New York State — Views of Morris Cohn, Jr., and John L. Harper of the Niagara Falls Power Company

TO SPEAK of water power in connection with the industries of New York State—particularly those of the western tier of countries—is to bring to mind instantly Niagara Falls, with its great present and far greater future part in hydro-electric development. No men probably are more competent to tell just what this means to the state and the nation than Morris Cohn, Jr., vice-president and general counsel, and John L. Harper, vice-president and chief engineer, of the Niagara Falls Power Company. In discussing the power situation on the Niagara frontier, Mr. Cohn said, recently:

"From 1850 until the last few years water-powers were more or less discredited. The invention and development of the steam engine, the enormous supplies of cheap coal, the disinclination of manufacturers to be influenced in their location by the question of power alone, made water powers of much less value and importance than they are now. Moreover, the difference in cost between electric energy produced from coal in large units and stations under favorable conditions and the cost of hydro-electric energy was not enormous until very recent years. The location of an ordinary manufacturing plant today is seldom controlled by the cost of power alone. Accessibility of raw materials, labor markets, transportation facilities and other factors determine the site of most industries. At Niagara Falls it was the rise of the electrochemical industries of the United States that gave a measure of early success to the power development, or perhaps, rather, the cheap power at Niagara Falls gave rise to the electrochemical industries of the United States, making that point the electrochemical center of America and probably of the world.

Early Opposition to Use of Falls

"A great many years ago, when water power was a drug on the market, the Hydraulic Power Company sought the consent of the city of Buffalo to enable it to deliver hydro-electric power in that city. The application was not favorably acted upon, and the owners of the hydraulic property for many years worked diligently to procure customers for its power nearer home. About the year 1902 a commission was appointed by the federal government to investigate the desirability of prohibiting further diversions of water from the Niagara River for power use. Niagara Falls had no representative upon that commission, but one of the most distinguished citizens of Buffalo was a member of it and reported in favor of a limitation of the diversion of water for power purposes here to an amount of less than 20,000 cu.ft. per second. That he and the other members of the commission sincerely believed, as did the Congress at that time, that the preservation of the scenic grandeur of Niagara Falls required this limitation is undoubtedly true. We, at Niagara Falls, did not then believe and do not now believe that such limitation of

diversion is necessary, and we believe that far greater benefits will come to humanity from the lifting of this limit than can come from its continuance.

"I am heart and soul for a greater hydro-electric development at Niagara Falls. At least double the amount of water now being used could be diverted here for power purposes without injury to the navigability of the lake or river and without injury to the scenic grandeur of Niagara, provided that suitable remedial works were constructed to regulate the flow of the water. One million horsepower additional ought to be available on the American side of the Niagara River in the next twenty years. I am sure that the development from such additional diversion would be of great value to our nation. Indeed, so highly is Niagara regarded industrially that there are some who declare a belief that had Germany possessed Niagara Falls and the Allies had no equivalent source of energy, the result of the war might have been different.

"From about 1896 to 1915 substantially all of the electric energy distributed in Buffalo was hydro-electric energy from Niagara Falls. Wise men in Buffalo, like C. R. Huntley and Mr. Urban of the Buffalo General Electric Company, long before 1915 saw what was coming. Effort after effort was made at Washington to allow the limit of diversion to be increased, but at every hearing and on every occasion some one professing to represent the city of Buffalo put his foot in the door and prevented favorable action.

"Hopeless of any relief in this direction, the officers of the Buffalo General Electric Company, with foresight and courage and real patriotism which must always be to their credit, raised millions of dollars and entered upon the construction of its wonderful steam-electric plant in Buffalo. I hope that some time the people of Buffalo will recognize the debt of gratitude they owe the Buffalo General Electric Company for building this steam plant, which certainly saved Buffalo from an industrial collapse during the period of the war. Still, the Buffalo company now receives approximately 70,000 hp. from the hydro-electric developments on both sides of the Niagara River, and I think I am safe in saying that its charge per kilowatt-hour for hydro-electric power is far less than the rate at which the tax-free Hydro-Electric Commission of Ontario delivers electric energy at the city of Toronto."

SIXTY PER CENT OF FLOW CAN BE SAFELY DIVERTED, SAYS MR. HARPER

In a recent address before the American Electrochemical Society at Buffalo, John L. Harper, chief engineer of the Niagara Falls Power Company, who has been largely responsible for the present power development at Niagara Falls, among other things said: "Water powers may be divided into two general classes —those in which the rate of development may be controlled by full or partial water storage and those in which no storage is possible. To the latter class belongs Niagara Falls. The ideal load for this second class of water powers is electrochemical and metallurgical processes where the use factor is large and where the cost of power entering into the process is large compared with the cost of labor. Such is the character of 95 per cent of the industries that the company serves at Niagara Falls, established right at the source of power. For the future development of these industries the supply of electric energy is of grave importance. With the present flow of Niagara Falls of 210,000 second-ft. it has been shown that 60 per cent could be diverted for power purposes without marring the beauty of the falls. To secure this diversion we have worked out a plan for placing concrete booms in the upper river so as to divert the water from the channel and spread it over the falls to cover completely the rocks that now show through at the edges because of the corrosion and wearing away of the channel at the middle of the falls. By the diversion of 60 per cent of the river flow there would be available 3,600,000 hp., and the remaining 40 per cent under the conditions stated would not only discharge ice during winter but improve the scenic beauty during summer."

In May, 1918, the United States government authorized the extension of the hydraulic plant of the Niagara Falls Power Company, and nineteen months later the first of three 37,500-hp. units was placed in operation. To appreciate more fully the small element of time consumed in this construction it is necessary to resort to comparison with earlier power-plant construction. In 1886 authority for power development was granted the Niagara Falls Power Company. Col. C. B. Gaskill, Thomas Evershed and William B. Rankine bore the great burden of organizing and planning the project, while its financing fell upon the shoulders of Edward D. Adams and Francis Lynde Stetson. It was not until October, 1890, that actual construction work was begun. It was five years lacking a few weeks before the first electricity was delivered, in August, 1895. A year later the first electricity was transmitted to Buffalo.

The hydraulic plant of the Niagara Falls company has been built, extended and operated for the last forty-six years almost exclusively by members of the Schoellkopf family, the third generation of which now furnishes the president of the consolidated company in the person of Paul A. Schoellkopf.

TOTAL CAPACITY OF NIAGARA FALLS COMPANY'S PLANTS

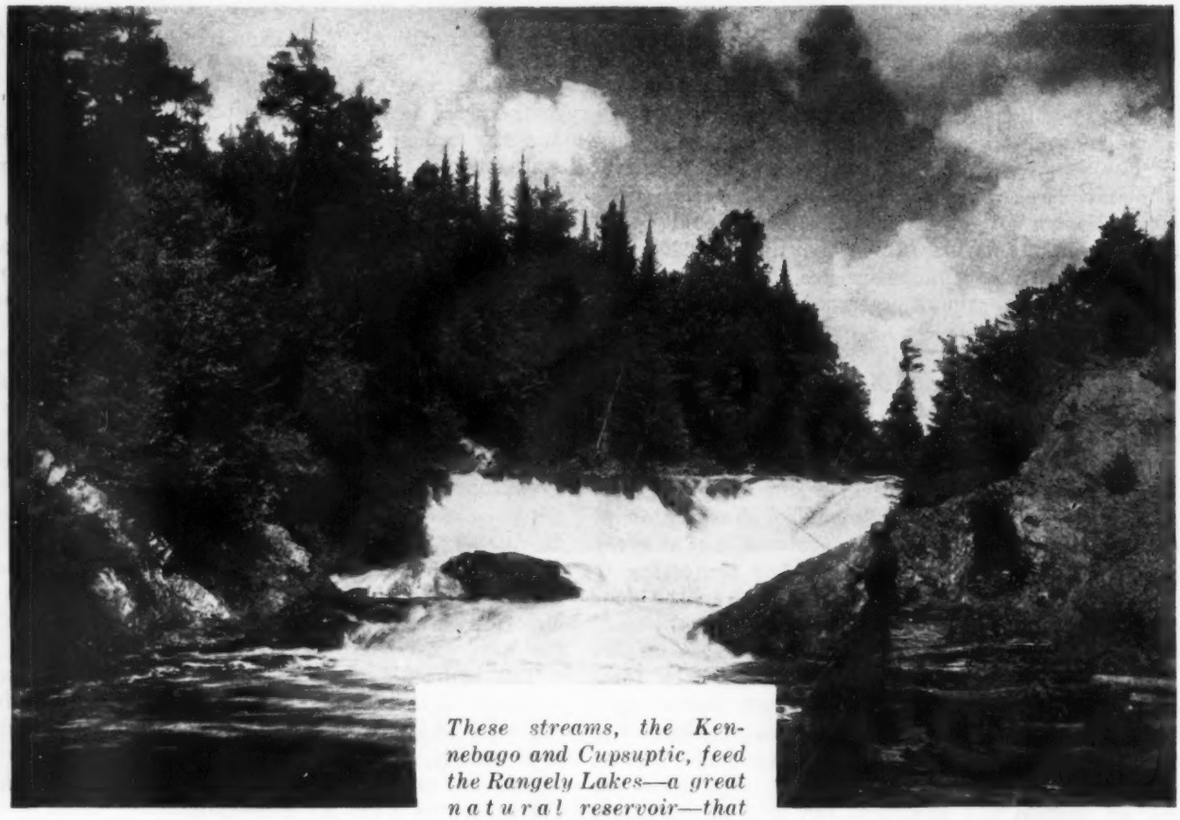
The following table shows the installed capacity of the plants now operated by the Niagara Falls company:

	Rating in Hp.
Niagara No. 1	55,000
Niagara No. 2	61,500
Hydraulic No. 2	26,500
Hydraulic No. 3	242,500
Canadian Niagara	112,500
Total	498,000

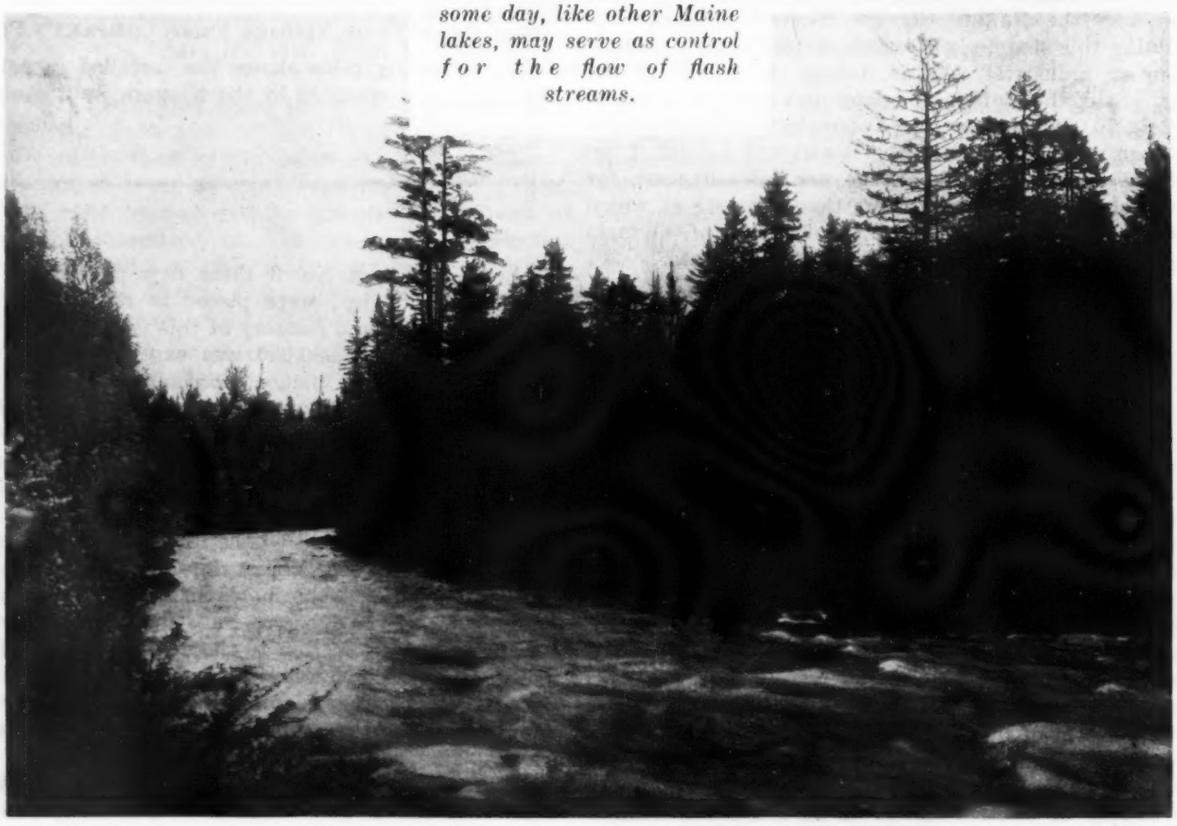
In hydraulic plant No. 3 three new generators, each rated at 37,500 hp., were placed in operation during December, 1919, and January of this year. On this new extension about $8,000,000 was expended in carrying into effect the river channel deepening, hydraulic canal deepening, lower basin enlargement, construction of the new forebay, the three large penstocks driven through solid rock from top to bottom of the high embankment, and the construction and equipment of the power-house addition. An efficiency of about 22 hp. per cubic foot of diversion is obtained by the large new units, and 93 per cent efficiency of the water will be obtained, as against 10 per cent obtainable in power from coal.

The plans of the Niagara Falls Power Company propose further construction to the extent of probably six more units of 32,500 kva. rating. This is intended for the purpose of redeveloping the water now diverted by the plant of the company on the upper Niagara River. This work will not, however, be started until after the water-power bill now before Congress becomes a law and the commission authorized thereunder has sanctioned it.

Two Sources of Potential Power in New England



These streams, the Kennebago and Cupsuptic, feed the Rangely Lakes—a great natural reservoir—that some day, like other Maine lakes, may serve as control for the flow of flash streams.



Pond-Level Control for Hydro Plants

Relative Advantages and Disadvantages of Eleven Methods in Use—Value of Installing Automatic Gates Calculated for a Specific Plant—Methods of Making Gates Dependable

By EARL STAFFORD
Engineer with John F. Vaughan Engineers, Boston

ONE of the most neglected features of water-power development is control of pond level to secure maximum head at all times of the year. The larger public utility developments are more careful in this respect, but smaller ones and private plants built for supplying power to mills often waste a great deal of power as a result of insufficient preliminary study before constructing the plant or as the result of careless operation.

Riparian rights and back-water conditions causing interference with plants in most cases determine maximum pond levels. Ordinarily the height of the dam is fixed to give sufficient depth of flood water on its top for passing the maximum flow of the river without exceeding the allowable pond elevation. This depth depends upon spillway length, but is rarely less than 6 ft. (1.8 m.), and is often two or three times as much. Head lost during the greater part of the year in such instances on the medium and low-head plants most common in New England amounts to from 5 to 15 per cent. During dry parts of the year removable flashboards which are used add only a few feet of head. Moreover, boards are often washed away by occasional small floods, causing waste of material and additional labor for replacement. Usually a week is lost before the water is again raised to the top of new boards. Where plant operation calls for drawing the pond to absorb night flows, there is a more or less constant labor charge for keeping boards tight; conversely in many instances water is wasted.

Eleven Methods of Control Considered

Several devices have been developed for installation on top of the dam for keeping the pond level always at or near the maximum allowable. Most of them depend upon human control. They must be opened and closed according to the volume of water flowing. Sudden floods coming at night before gates can be opened would result in considerable damage, often with loss of life. The following list covers the more important devices used to regulate pond levels and provide discharge capacity for floods: Pin flashboards, hinged flashboards, needles, submerged sluices, chanonine wickets, vertical gates between piers—sliding type, Stoney type, tainter gates, swinging gates hinged horizontally—bear traps, rolling gates, and automatic swinging leaf gates.

Flashboards supported by pins or horses may be used to increase the head from 1 ft. to 6 ft. (0.3 m. to 1.8 m.) intermittently. In most cases their use requires considerable labor and material maintenance charge. Except for large storage areas with small fluctuations in elevation, the use of flashboards generally gives less head than can be obtained by control gates.

Hinged flashboards pivoted about the lower edge and supported by an inclined prop are not new, but their construction and operation have lately been brought to a more refined state of development. They are working successfully on large rivers where frequent floods, log driving and severe ice conditions make the pin type of board unsatisfactory. In one case they have withstood treatment so rough that ash planking with grain running vertically was used to eliminate the splintering caused by floating objects striking crossways to the grain. A button fastened to a cable on the downstream side of the top of the dam, when pulled along, trips the prop of each section successively. When properly built the sections drop down without breaking, regardless of whether water is going over the tops. They are made about 4 ft. (1.2 m.) wide and have been built to stand 4 ft. high with 2 ft. (0.6 m.) overtopping. When down they may be raised by hand after the water has dropped to within a foot of the level of the hinge by standing behind the section already raised and working successively along the crest. Men working from a cableway have no special difficulty in reaching down through several feet of water to fasten a hook which pulls the section up sufficiently to allow the prop to drop in place.

Needles, Submerged Sluicegates and Chanonine Wickets

Needles or vertical stop planks require a bridge across the top of the dam. Their use is restricted and few dams are equipped with them today. Maintenance and operating costs are relatively high.

Submerged sluicegates have in some instances given satisfaction when used for flood control. In the majority of cases, however, there is trouble, either from gates and gate mechanism jamming or gate openings clogging with débris, or erosion of masonry downstream by scour of the water at high velocity. The difficulty of repairs makes their use undesirable.

Chanonine wickets and similar devices consist of a hinged leaf held nearly vertical by braces or props which are tripped automatically by the pressure when the water level gets too high, allowing the leaf to fold down flat. They are subject to being put out of order by débris or by cold weather and are not in common use.

Gates That Swing or Slide Vertically

Vertical gates sliding up and down between piers require expensive hoisting mechanisms. Ice forming in the gate grooves and along the top edge makes it very difficult to open them in the winter. The Stoney type runs on a roller nest which reduces friction to a point where the gate hoist is considerably lightened. Such gates have had wide use on many important dams, even in very cold climates. Steam-heating coils around the gate grooves and inside the gate (of hollow-steel construction) have been partly successful in eliminating ice troubles. In many instances other types will accomplish the work of these gates at less cost.

Tainter gates consist of a cylindrical face which swings up out of the water about a pivot. Like vertical gates they require division walls or piers at intervals along the top of the dam. These gates are made of steel or wood and work out more economically than sliding gates. As there are no gate grooves at the pier face, the chopping out of ice for opening is much

easier. Steam heating has been used with success. Instances where tainter gates have not worked out well are the result of faulty design. The tendency often has been to make gates of too light a construction, and they have been broken by ice or floods which overtopped them.

Swinging gates hinged about the lower edge are raised by cables or chains extending from the top edge to hoists on a bridge spanning the piers between which the gates work. Since the hoist cables must carry from one-half to one-third of the total water pressure, the hoisting mechanism is heavy and expensive. Gate movement, as in the case of tainters, is dependent upon human control. Except for this and the heavy hoists, these gates have the advantageous features of the automatic type described later.

Bear traps are inverted "V"-shaped structures made by two flat leaves hinged horizontally, one at the up-stream and one at the downstream side of the top surface of the dam, their top edges meeting and hinged by sliding links. A continuous surface on the up-stream and down-stream sides is formed. Movement up and down to suit the pond elevation desired is by changing the angle of the "V." When arranged so that the movement is caused by water pressure from the pond, admitted to the hollow space under the "V," hoists are eliminated and the gates are relatively simple mechanically. While subject to ice troubles, they are working successfully on many dams. They are usually placed on dams at the outlet of storage reservoirs and are kept from being frozen in by allowing a stream of the relatively warm pond water to flow through them. Large gates of this type are costly.

Rolling gates are a type of automatic gates little used in this country, though there is one large installation in the West. Many of all sizes are in use in Switzerland. The moving part consists of a large hollow-steel cylinder of a diameter equal to the depth of water to be controlled. When it is desired to pass a flood, the gate rolls up on a track at the abutment piers and allows the water to flow beneath. First cost is one of the chief reasons why other types have been used instead.

SWINGING-LEAF GATES HAVE DESIRABLE FEATURES

Swinging-leaf automatic gates are the latest development, and their reliability and simplicity should appeal to all when their value becomes known. They consist of a swinging leaf, hinged horizontally at the top of the permanent part of the dam, which through a system of balancing levers and counterweights allows the gate to swing up or down and discharge water over the top edge according to the volume of water flowing. The pond level meanwhile will vary only a few inches, regardless of whether the flow of the river is at maximum flood or minimum low. The sloping upstream face and curved top edge are favorable to the passing of large ice cakes, logs or débris. When such objects strike the gate they push it down and slide over the top. This type of gate has been used successfully under the most severe winter conditions. Since there are no grooves or pockets or sliding parts, possibility of ice trouble is practically eliminated. Sizes as used in this country range from 7 ft. high by 46 ft. long (2.1 m. x 14 m.) to 10½ ft. high by 64 ft. long (3.2 m. x 19.5 m.). The design of such gates may be adapted to larger or smaller sizes according to the demand. First cost is no greater than for any other non-automatic gate for the same purpose and is very small when compared with power gained over that from using flashboards. It is only a question of time before they will come into common use. Development in Europe and successful demonstration of the reliability of these gates has taken place in the last few years, during which there has been little water-power work done. Designers of new plants that will be built with the coming activity should carefully consider this type of control gate.

ACTUAL VALUES OF AUTOMATIC GATES

The following hypothetical case showing the value of the automatic gates just described is based upon an actual plant for which studies of development have been made:

Maximum allowable pond level during spring and fall floods 6 ft. over top of dam, during remainder of the year 3 ft.
Head as developed at present (ft.) 20
Possible to add by providing discharge capacity for small floods (ft.) 3
(Flashboards not suitable here because floods from ordinary rains would cause the water to flow over their tops several feet deep before washing them away, causing damage to crops along the banks.)
Spillway length (ft.) 250
Normal rated capacity of plant at 20-ft. head (kw.) 500
Maximum continuous rated capacity at 23-ft. head (kw.) 615
Annual load factor (per cent) 50
Ten per cent of the year flood flow causes rise in headwater and tailwater levels so that average head on plant is but 20 ft. (6 m.) and it cannot be increased by any control device on dam.
Fifteen per cent of the year the flow is equal to or greater than plant can use, and without any control device on dam the average head on plant is 20 ft., but with automatic control it varies with tailwater level and averages about 22 ft. (6.7 m.).
Twenty-five per cent of the year the flow is about equal to plant demands and with automatic control the average head is increased to 24 ft. (7 m.).
Fifty per cent of the year the average flow is about equal to one-half normal rated plant capacity, or 250 kw. continuous at 20-ft. head and with automatic control the head is increased to 23 ft. and the same average flow is equal to 287 kw. continuously.

TABLE I—VALUE OF INSTALLING AUTOMATIC GATES FOR SPECIFIC PLANT

Comparative Head and Outputs:	As At Present		With Automatic Control Gates	
Per Cent of Time	Head (Ft.)	Output (Kw.-hr.)	Head (Ft.)	Output (Kw.-hr.)
10	20	220,000	20	220,000
15	20	330,000	22	380,000
25	20	550,000	23	630,000
50	20	550,000	23	630,000
Total annual kw.-hr.		1,650,000		1,860,000
Kw.-hr. added by using automatic control				210,000
Value at prevailing rate of 1.3 cents with coal clause; coal at present price: 1.7 cents × 210,000				$3,570
Condition as at Present:				
Flow causing rise of 3 ft. over top of dam (c.f.s.)				5,000
Maximum flow during spring floods (c.f.s.)				12,000
Depth over dam at flood stage (ft.)				6
New Arrangement Maintaining Same High-Water Condition:				
With water 3 ft. above top of present dam, two gates, 40 ft. x 7 ft. discharge (c.f.s.)				5,000
With water 6 ft. above top of present dam, two gates, 40 ft. x 7 ft. deep discharge (c.f.s.)				9,000
Remainder of spillway, 165 ft. long built up permanently, 3 ft. with 3 ft. of water over top (c.f.s.)				3,000
Total				12,000
Cost of permanent wooden flashboards on part of dam 165 ft. long, 3 ft. high				$500.00
Cost of two gates, 40 ft. x 7 ft. each				5,600.00
Engineering and miscellaneous				1,900.00
Total				$8,000.00

Result:
Annual increased income of $3,570 is nearly 50 per cent of first cost, and with the exception of about 15 per cent of the year, when flood conditions reduce the head, 23 per cent is added to the capacity for peaks and emergencies. On a more flashy stream, where more free board is recoverable, automatic gates would be of even greater value.

TABLE II—AVERAGE INCREASE IN CAPACITY AND OUTPUT THAT MAY BE OBTAINED BY THE INSTALLATION OF AUTOMATIC GATES (LOAD FACTORS TAKEN AS 50 PER CENT)

Head (Ft.)	Average Freeboard Allowed (Ft.)	Recoverable Under Average Conditions (Ft.)	New Head (Ft.)	Capacity Added to Waterwheel, Per Cent	Annual Output Added, Per Cent
8	4 to 6	3	11	60	30
10	4 to 6	3	13	47	25
12	4 to 6	4	16	54	25
14	4 to 6	4	18	45	25
16	5 to 7	4	20	40	25
18	5 to 7	5	23	45	25
20	6 to 8	5	25	40	20
25	6 to 8	6	31	38	20
30	6 to 8	6	36	31	15

Automatic gates can be installed more economically on new developments where the layout is planned for their use, but there are a great many cases where they can be placed on old dams with very little extra expense. They work out best when added to short spillways on small or medium-size rivers. The head that is recoverable is comparatively large and the gates may be placed over the entire length of spillway. Additional construction involved in any case consists mainly of concrete piers, 30 ft. to 40 ft. (9 m. to 12 m.) apart, and changes at the crest of the dam for attaching the gate. By making deep gates it is unnecessary to extend them entirely across the spillway; the remaining part may then be permanently built up with wood or concrete to new pond level.

When plants are tied in with public utility systems under an arrangement for exchange of power, the load factor is usually high, sometimes to the point of requiring all the power available except in the rainy season. Automatic gates for such plants may be extremely valuable. For instance, in the hypothetical case cited above the annual income would be almost doubled (equal to the first cost of the gate) if the plant were tied into a system requiring twenty-four-hour load.

OPERATING PROBLEMS AND SOLUTIONS

The chief objection to gates for providing flood discharges is that they are not infallible. No risks can be taken that may allow unexpected floods to overtop and destroy the dam. Human operation may fail through carelessness, or gates may be frozen in or jammed, or the operating mechanism may get out of order. The new type of automatic gates is free from such objections. They are operated by the rising pressure of the water and are entirely independent of human control. There are no gears or mechanical devices that will break or jam. The water pressure on the long movable face of the gate increases very fast as the pond level rises. Any obstruction or ice frozen around the ends will be sheared off before any great rise in pond level has occurred. For instance, a gate 50 ft. (15 m.) long and 4 ft. (1.2 m.) high, if held against the water pressure until the level rises 2 ft. (0.6 m.), would be subjected to an additional pressure of 27,000 lb. (12,000 kg.) tending to push it open.

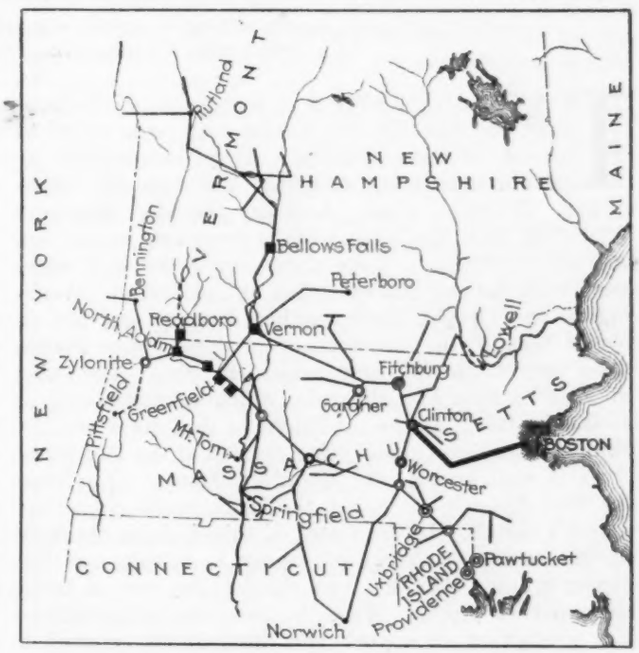
Siphon spillways, where permissible, allow the permanent crest of the dam to be built practically at maximum pond level. Their use is restricted, however, to localities where there is no ice at times of high water and where débris is not of sufficient size and quantity to clog the throat of the discharge tube. They are inapplicable to any developments on our Northern streams and to most of those on Southern rivers.

A new patented idea for eliminating ice troubles around all kinds of gates was successfully tried in Michigan in 1917. It is applicable to installation of gates on deep ponds. Water is drawn from the bottom of the dam by a centrifugal pump and piped to outlets along the gate pier faces. This water is relatively warm, and only a small amount is required to keep an open pool around the upstream face of the gate. Power required is negligible, as the pump works only against the friction head of the circulating pipe.

Compressed air has been used with perfect success in preventing ice from freezing around the large vertical sliding-type gates. A pipe extending the length of the dam fed by a low-pressure blower at one end supplies each gate through branches which extend under the water around the piers and along the gate. The air bubbling up through the water causes sufficient circulation of the deeper, warmer water to prevent freezing. Each branch is controlled by a valve, and it is only necessary to treat the gates intermittently at times when ice is forming.

Generating Capacity of 500,000 Kw. Interconnected in New England

CONTINUOUS electrical connection has been established from the Berkshires to the edge of Cape Cod, tying together about 500,000 kw. in steam and water-power stations. This interconnection was made by the

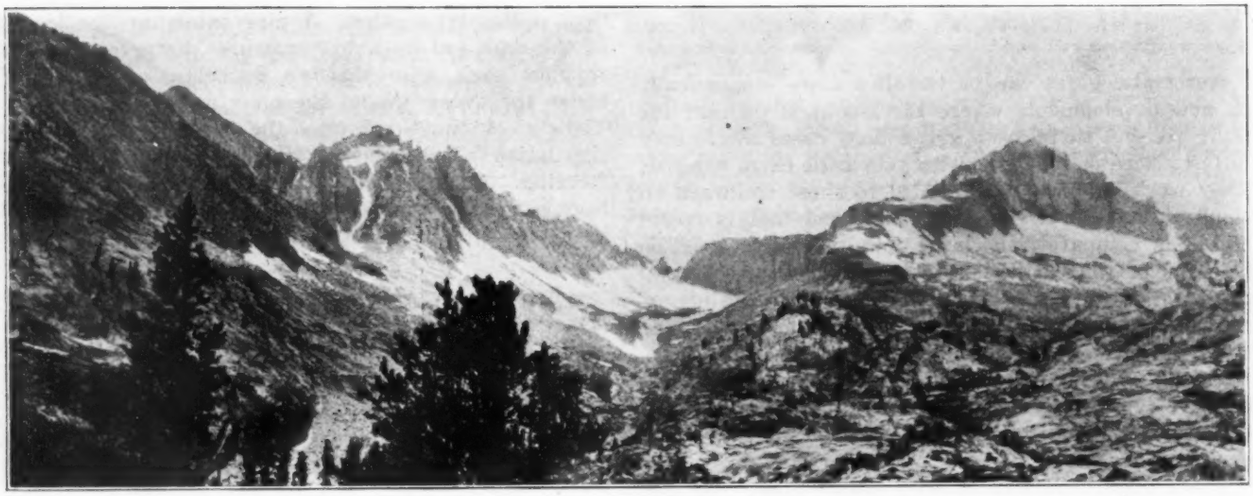


TIE LINE CONNECTS THE POWER SYSTEMS OF BOSTON WITH THOSE OF WESTERN NEW ENGLAND

completion of the 25,000–66,000-volt line between the New England Power Company and the Edison Electric Illuminating Company of Boston, Mass. Among the stations interconnected are the hydro-electric plants of the Harriman system on the Deerfield and Connecticut Rivers and of the Turners Falls Power & Electric Company on the Connecticut and the steam stations of the Springfield, Worcester, Providence, Boston, Salem, Fall River, Eastern Connecticut and other companies. By taking advantage of the demand factor and a varying water supply it is estimated that more than 500,000 tons of coal per year will be saved by the co-operation of these systems.

Prospective Power Development in the Far West

Inactivity in Copper Mining, Financial Situation, Cessation of Shipbuilding and Need for Further Interconnection Delaying Some Development—Conditions More Favorable in Idaho and California



SNOW-CLAD PEAKS, AMONG WHICH IS MOUNT WHITNEY, THE HIGHEST MOUNTAIN OF THE UNITED STATES, FROM WHICH KINGS RIVER, CAL., DEVELOPMENT IS TO BE FED

IN A CONSIDERATION of hydro-electric development the Far Western States may be assumed to consist of three principal groups determined by certain underlying economic and financial conditions: Colorado, Utah, Arizona, Nevada, Montana, Wyoming, New Mexico and Idaho constitute one group. All the companies in these states are in the same category with the possible exception of one or two. Washington and Oregon form another division and are so placed because the development in those states hinges upon very much the same basic principles. The third division consists of California, which is thus placed in a class by itself, as the conditions in that state are dissimilar from those in any other portion of the Far West.

As is well known, the Mountain States, comprising the first division noted, are the large producers of the nation's metals. In the states of this division the bulk of the country's output of copper is mined, and the copper-mining industry was during the war a large consumer of power. With the cessation of hostilities the production of copper was immediately curtailed. The loss of the copper and other mining loads in the Mountain States placed the power companies in a position where they did not find it necessary immediately to increase their generating capacity. With the reduction of the activities in the mining industry a large proportion of the normal population went to other fields, and this further reduced the demand upon the power company.

One exception of note in the intermountain district is the Idaho Power Company, which is at the present time making some small additions to its generating capacity. In this territory the further reclamation of land by irrigation is considered of the greatest importance in connection with the continued development of the states and their resources. Irrigation projects are generally considered to be entitled to a special rate for electric service. Such a rate was put into effect in 1915. Unfortunately the irrigation business of the utility company has been growing faster than other classes of business; consequently the development rate has been working a great hardship on the utility, since additional power-plant and transmission-line investments are required every year to take care of a business that is not self-supporting and which is growing so rapidly that other lines of business cannot compensate for its losses. This is particularly true in view of the rapid increase in operating costs during the five years in which a fixed development rate has been in effect and during which there has been no change in the rate.

In the extreme Northwestern territory the further immediate development of hydro-electric power is held in abeyance for three principal reasons. First and most important of these is the financial situation. At the present time it does not seem possible for the power companies to obtain revenue as a return on their investment sufficient to encourage further investments. This is not due entirely to lack of proper water-power legislation, although power companies cannot amortize their investments in a hydro-electric plant during the period of the proposed lease term. A more cogent reason is that the revenues permitted are not sufficient to warrant further great increases in investment. The only remedy for this phase of the situation is the immediate increase of rates to an extent which will make the securities of the power companies comparable with those of other high-class investments.

In the states of this division there were important war industries which were large consumers of power, such as the shipbuilding and allied industries. With the armistice and the cessation of work in shipbuilding activities the power companies of this territory met

with a decrease in load. This, however, at the present time has been largely recovered in other ways.

The hydro-electric developments which are to be considered next are to a great extent those which are best developed in large units. These projects may only be developed after more extensive interconnection of the several systems, since it would be economically unwise for any of the companies operating separately to undertake the development of a block of power many times greater than it could itself immediately utilize.

With the exception of the Skagit River development of the city of Seattle, no very large project is now under way. Two of the large companies of this territory are so situated that they will not require further extensive hydro-electric development during the immediate future. Some years ago the Washington Water Power Company made what is known as the Long Lake development, where the initial installation of generating units was less than the ultimate capacity of the project. For this reason the company will have only to install additional generating units in order to keep pace with the further growth of load. Recently the Northwestern Electric Company, operating in Portland, Ore., has completed a 45,000-hp. steam generating plant burning hogged fuel. The present capacity of this plant is sufficient to take care of the company's load in the immediate future, and it is expected that further increases in load will be met by increasing the capacity of the plant and, in part, by a development on the Lewis River which, it is expected, will necessitate an ultimate expenditure of $5,000,000. The company has for some time had surveyors at work on this project to determine its feasibility.

The great increase of hydro-electric power in California is due to two principal reasons: First, California is rapidly developing as an industrial and agricultural district; second, the rates allowed by the California State Railroad Commission are such as to encourage capital investment.

In connection with the first point it should be noted that during the last six months the water sources covered by applications for irrigation have been sufficient to irrigate one and one-half times the land now under irrigation, or approximately 26 per cent of the total irrigable area of the state. This, in turn, is due to the rapid increase in population and the fact that there is sufficient hydro-electric energy available for raising the water necessary for the irrigation of these lands. That rates are reasonable and are being adjusted from time to time to meet the demands of the increasing cost of installation and operation is undoubtedly one of the greatest factors in the rapid development of hydro-electric power in California. If it were not for this, that state would in all probability be in the same situation as the states of the Northwest.

PLANS FOR DEVELOPMENT IN DIFFERENT STATES

Idaho. The Idaho Power Company is now installing a 6,000-kw. turbine in its Thousand Springs station, which is an appreciable percentage of the rating now installed (36,000 kw.) on the whole system. The increased demand for power over the entire system of the Idaho Power Company during the past year has been exceptionally large, and it is anticipated that the coming year will see a consistent increase in its load, which is largely for agricultural purposes.

An interesting development in Idaho is that called the Sand Spring Irrigation Project. In the Box Canyon of the Snake River there is a spring which has an average flow of 450 second-ft. (12.6 cu.m. per second), the records showing that this flow is very seldom departed from. This spring is to be utilized in a 7,000-hp. plant operating under a 200-ft. (60 m.) head. Energy will be transmitted 1 mile (1.6 km.) to the Sand Springs pumping plant, where water will be lifted into two irrigation canals, one 56 ft. (17 m.) above the pumping plant and the other 100 ft. (30 m.) above the pumping plant. Approximately 1,500 kw. will be utilized in this plant, the remainder being available for the use of the nearby farming and industrial industries.

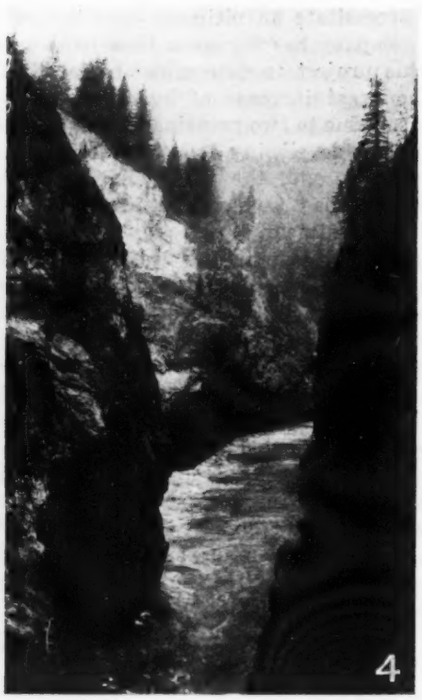
Montana.—According to the reports of the Department of the Interior, the State of Montana contains potential water-power resources equal to 8 or 9 per cent of the total of the United States. However, only a small proportion of the available power has been developed. In addition to the plants already built and in operation, there are a large number of large power sites and numberless smaller ones ready for development as soon as the demand for power increases and there is available capital for their construction. Although these possible developments are in all parts of the state, the largest possibilities exist in the northwestern section of Montana, where the waters of the Flathead and the Kootenai River and other large streams will, when harnessed, furnish more than 500,000 hp. The power site at the mouth of the Flathead Lake, which is one of the most feasible in the state, has been reserved by the Government in connection with the reclamation system covering a portion of what was formerly the Flathead Indian Reservation. A number of smaller power sites have also been reserved, while many others are under private ownership.

The proposed developments of the Montana Power Company amount to 100,500 kw. and include the following: Madison No. 3 on Madison River (20,000 kw.); Great Falls "C," on Missouri River above Great Falls, (28,500 kw.); Sheep Creek on Missouri River below Great Falls (28,500 kw.); Fish Creek on Missoula River (13,500 kw.); Black Eagle on Missouri River, reconstruction project (10,000 kw.). With the generating facilities that the Montana Power Company now has, it appears that even with an increase in load of 10 per cent per year it will be four or five years before the load equals the present installed capacity. An average increase in load greater than 10 per cent per annum might be expected, provided that the mining industry shall be restored to a normal basis and the electrification of railways continue as the present indications are that it may continue. In this event the surplus capacity of the Montana Power Company may be reached within the next three years.

Oregon and Washington.—Three water-power developments are contemplated in Oregon: (1) The Enterprise Electric Company is planning the construction of a 4,400-hp. plant on the Wallowa River in Oregon. (2) Application has been made for the diversion of 5,000 second-ft. (140 cu.m. per second) of water from the Deschutes River for power development. This project is waiting favorable action on the water-power bill and proper methods of financing. (3) Another application has been filed seeking the diversion of 600 second-ft. (16.8 cu.m. per second) from the north fork of the Santian River for one development of 6,500 hp. Walla Walla, Wash., is now contemplating the development of a small municipal plant on one of the streams in western Washington. The proposition has been prepared for placing before the voters.

417,000 Hp. Available in These Four Sites

Power available here exceeds that developed in Arizona, Colorado and Nevada.



No. 1. Diamond Creek site in Arizona where 140,000 hp. can be developed and utilized for railroad electrification, mining and general public use in the Southwest, all within economical transmission distance. Oil, which is fast becoming scarce and increasing in price, would be saved and industrial development stimulated.

No. 2. The 18,000 hp. now provided in the Shoshone plant of the Colorado Power Company for Denver and vicinity is only one-half of the power available in the Grand River Canyon above Glenwood Springs. Here again railroads, industry and the public could utilize the power to advantage.

No. 3. Development of Sherar Falls on the Deschutes River, Ore., should provide 40,900 hp. dependent on a market. About 500,000 hp. is available in the entire river, but power will probably not be developed until it becomes feasible to generate part-year power. Reservoir capacity, is available to permit complete control of flow.

No. 4. 200,000 hp. could be developed in Z-Canyon, Clark Fork, Wash., by damming this narrow chasm, but an industrial demand would have to be stimulated coincident with development. Railroad electrification and development of industry offer possibilities.

California.—In California the construction of hydroelectric plants was delayed during the war period, owing to the necessity of curtailing the use of material essential for the conduct of the war. Consequently the power companies of California found themselves upon the signing of the armistice seriously short of generating capacity. The load had increased steadily during the war period, and it was only due to the fact that previous to the war the capacity somewhat exceeded the requirements, that the companies were able to permit their load to increase.

Immediately following the signing of the armistice the Southern California Edison Company issued new securities to the extent of $10,000,000, the money from which has been used in the development of plants on Big Creek and the Kern River. The development on Big Creek includes the installation of an additional 16,000-kw. generator in the Big Creek No. 1 plant, to be placed in operation during the summer of 1920. Construction work is under way on a storage reservoir at Shaver Lake to impound the drainage from 32 square miles (83 sq.km.) naturally tributary to this basin, and additional waters from other sheds at those times when the runoff exceeds the capacity of the No. 1 plant. The water from this reservoir will be utilized in the Big Creek No. 2 plant and in the lower plants. Work is also under way on the construction of the Big Creek No. 3 power house, which will be the largest of the developments on this stream and will have an ultimate capacity of 175,000 kw., utilizing the entire flow of the San Joaquin River and Big Creek after its utilization in power houses further up stream.

Construction work on the Kern River No. 3 plant of the Southern California Edison Company has reached such a stage that it is expected this plant will be in operation during the fall of 1920. As pointed out in the July 19, 1919, issue of the ELECTRICAL WORLD, this plant will consist of two 15,000-kw. generators driven by reaction turbines operating under 800-ft. (244-m.) head.

The Bureau of Power and Light of Los Angeles is now constructing the San Francisquito No. 2 power house, and it is expected that this plant will be in operation during the summer of 1920. This plant will have a capacity of 20,000-kw., and since it is directly on the line of the Los Angeles Aqueduct it has not involved a large expenditure for construction of water conduits.

The San Joaquin Light & Power Company is rapidly completing the construction of a 30,000-kw. plant on the San Joaquin River, to be known as the Kerckhoff plant. The static head from the normal height of water in the dam to the water in the tailrace will range from 350 ft. to 310 ft. (107 m. to 94 m.), depending upon the height of the tailwater. Three vertical-shaft 15,000-hp. turbines, operating at 360 r.p.m., will be employed.

Another development by the San Joaquin Light & Power Company, one whch is planned for the near future, will be known as the Little Kerckhoff plant. This plant will be built just below the diversion dam of the larger Kerckhoff project, will be rated at 8,000 kw. or 10,000 kw. and will utilize the flood water of the San Joaquin River in excess of those which the larger plant can handle.

The Kings River power development of the San Joaquin Light & Power Corporation, located on the north fork of Kings River, will be developed within the next few years. It has a total reservoir storage of 202,200 acre-ft. (24,200 hectare-m.) and a rating of 271,250 hp. The storage is embraced in the three reservoirs—Lake Wishon, with 128,000 acre-ft. (15,350 hectare-m.); Deer Lake, with 21,000 acre-ft. (2,520 hectare-m.), and Bear Lake, with 53,200 acre-ft. (5,380 hectare-m.).

The power is derived from seven plants—Wishon, with 6,670 hp.; Haas, with 82,670 hp.; Balch, with 124,000 hp.; Bear Creek, with 2,600 hp.; Deer Creek No. 1, with 6,670 hp.; Deer Creek No. 2, with 26,670 hp., and Meyer, with 22,670 hp. The major power house of Balch has 45 per cent of the total power capacity of the development. The Wishon power house will divert 400 second-ft. (11.2 cu.m. per second) from Lake Wishon at a head of 235 ft. (72 m.); Haas will divert 400 second-ft. (11.2 cu.m. per second) from Wishon power house at a head of 2,475 ft. (753 m.); Balch will divert 400 second-ft. (11.2 cu.m. per second) from Haas and 200 second-ft. (5.6 cu.m. per second) from Deer Creek No. 2 at a head of 2,500 ft. (762 m.); Bear Creek power house will divert 150 second-ft. (4.2 cu.m. per second) from Bear Creek Lake at a head of 265 ft. (81 m.); Deer Creek No. 1 will divert 50 second-ft. (1.4 cu.m. per second) from Deer Lake at 1,465-ft. (447-m.) head; Deer Creek No. 2 will divert 150 second-ft. from Bear Creek station and 50 second-ft. (1.4 cu.m. per second) from Deer Creek No. 1 at 1,545 ft. (443 m.) head, and Meyer will divert 650 second-ft. (18.2 cu.m. per second) from Balch and the north fork of Kings River at 410-ft. (125-m.) head.

The expenditures necessitated on the Kings River project, not including engineering construction, will be approximately $25,500,000 up to and including the year 1924.

The Great Western Power Company is pushing construction on its Caribou plant, on the Feather River. This plant should be completed by about the first of 1921 and will have a capacity of 40,000 kw. Energy from the plant will be transmitted to the vicinity of San Francisco. The Caribou plant is to operate under head of 1,008 ft. (305 m.). The generators are to be rated at 22,223 kva. and each will be driven by two overhung impulse waterwheels. This plant will have two units installed at the present time with room in the present building for one additional unit, the ultimate capacity being six units of the above noted ratings.

The Pacific Gas & Electric Company is planning to proceed actively with construction work on the Pit River in the northern part of California. Pit River is remarkable for the reason that projects developed on it will not require the construction of storage reservoirs, as the lava beds in the high regions which constitute the source of the stream are themselves storage reservoirs. For this reason the flow of the Pit River continues without extreme variation throughout the year and from year to year. The development on this stream has been postponed in the past owing to its distance from the market and because of the necessity of investing in installation of considerable size at the first.

The Pit River development of the Pacific Gas & Electric Company presents a number of different possibilities in method of development. Surveys are being made at the present time to determine which of these should be developed first, having in mind the time required for construction. One of the larger developments will provide a head of some 940 ft. (284 m.) with a minimum river flow of 2,450 second-ft. (69 cu.m. per second). This will develop 138,000 kw. in this one

plant. The transmission lines necessary for this project will be to Sacramento and to San Francisco.

The Yuba Development Company in California is proceeding with the construction of its power and mining project on the Yuba River. It is expected that the dam, which will impound 25,000 acre-ft. (30,000 hectare-m.) of water will be finished in the fall of 1920 and will be utilized primarily for a débris catchment for the hydraulic mining operations farther up stream. It is planned to install a power house below the dam which will be capable of 5,000 hp. output during eight months of the year. Although the initial installation will consist of one 10,000 hp. unit, the full output will not be available continuously.

The Modesto-Turlock Irrigation District has voted bonds for the construction of a power and irrigation project on the Tuolumne River, the dam for which will be constructed in the immediate future. There is sufficient water in this stream to develop 17,000 hp. as a minimum and 45,000 hp. ultimately. The probable immediate development will consist of 30,000 hp.

The Sespe Light & Power Company is planning to

Some Sources of Water Power in the Far West

Upper view, left—Camp Verde, Arizona, dam site. Upper view, right—Sand Springs project in Idaho where joint development of power and irrigation is under way. Lower view, left—Pit River, Cal., where the Pacific Gas & Electric Company is making a large development. Lower view, right—Power-house site on the San Joaquin River, which river will ultimately produce 1,000,000 hp.

install three hydro-electric plants on the Sespe River in Ventura County, each having a capacity of 4,000 kw. or 5,000 kw. This project is as yet only in the development stage, and estimates are being made on the project as a whole. It is now estimated that the project will involve the expenditure of some $4,000,000, which will include works for irrigation.

The Snow Mountain Water & Power Company is going ahead with the construction of a dam in Lake County, California, to impound 73,000 acre-ft. (8,760 hectare-m.) of water. In addition to this, other plans contemplate the addition to their head generating capacity so as to effect a 25 per cent increase in capacity.

The Hetch-Hetchy project of the city of San Francisco is rapidly progressing. The Hetch-Hetchy dam will be the largest structure of its kind in the State of California, being constructed of cyclopean masonry. The completed reservoir will have a capacity of 346,000 acre-ft. (41,500 hectare-m.). The completion of the mountain division will develop 66,000 hp. in the Moccasin Creek power house. The ultimate development on this project will be 250,000 hp., which will include, besides the Moccasin Creek development, one called Early Intake (67,000 hp.), the North Mountain development (50,000 hp.) and a number of miscellaneous developments totaling 61,500 hp. There is already completed and in operation a small power house at Early Intake with a capacity of 4,500 hp., which is utilized for construction work.

In connection with the power development on the Hetch-Hetchy water will be carried by an aqueduct to San Francisco for general use.

Arizona Development.—Two main projects are under contemplation for development in Arizona, one being on the Colorado River at Parker and the other on the Verde River for the irrigation of the Paradise Valley.

The Parker River development will involve a dam which will store sufficient water to permit operation on a minimum flow of 7,500 second-ft. (210 cu.m. per second) the normal minimum flow of the Colorado River at this point being 3,000 second-ft. (84 cu.m. per second). The ultimate development at the Parker site will be 140,000 hp. Power from this plant may be utilized in the copper mines some 240 miles (385 km.) east of Parker. The preliminary work on this project has now been completed, and if the financial arrangements are carried out satisfactorily construction work will start within a period of one year.

The Paradise Verde irrigation project is of interest both from a power and from an irrigation viewpoint. The project contemplates the construction of three main dams and two smaller dams for diversion from two small creeks. The first dam, which will be called the Camp Verde Reservoir, will have a capacity of 440,000 acre-ft. (52,800 hectare-m.). Below this, on the Verde River, is to be constructed the Horse Shoe reservoir, with a capacity of 305,000 acre-ft. (37,000 hectare-m.). From the latter dam water will be taken to a canal and utilized in a 15,000-kw. power house situated above the Paradise Valley. From this point the water will be taken in a canal for the irrigation of the 95,000 acres (38,000 hectares) of the valley, and in those seasons when the utilization of water in the power house is in excess of that required for irrigation the surplus will be stored in a 50,000 acre-ft. (6,000 hectare-m.) reservoir on the New River, later to be returned for irrigation of land lying below the elevation of the latter reservoir. This project is now before the Department of the Interior, and a decision on it is to be rendered by the Secretary by May 1.

Reducing Discrepancies in Coal Weights

Difference That Manifests Itself Between Mine Weights and the Weight of Coal Burned Is the Cause of Inroads on the Revenue of Central Stations—Remedies for Situation Are Discussed

A CONSIDERABLE number of electric lighting and power companies have recently called to the attention of the ELECTRICAL WORLD the losses they are forced to bear on account of discrepancies in coal weights. One central-station executive remarked that in 1919 he had experienced a very wide difference between the weights of coal purchased and the weights of coal burned. His was an Ohio company with 2,000 kw. of generating capacity which used in round figures 10,000 tons of coal a year. His loss from discrepancy in weights in 1919 was about $2,200. Another central-station operator when asked for his experience replied: "During excessively cold weather the discrepancy between mine and delivered weights of fuel purchased by our company have reached as high as 8 per cent, while during the summer months they do not exceed 2½ to 3 per cent. It is my opinion that the average shortage through a period of a full year would be from 4½ per cent to 5 per cent of the total fuel purchased."

These statements and others show that the losses are of a magnitude deserving attention. Therefore in order to throw some light on the problem a letter was addressed to the National Coal Association. This letter outlined the problem and asked what might be done by individual electric light and power companies or by central-station associations to remedy the trouble. To this letter John Callahan, traffic manager for the National Coal Association, replied as follows:

COAL MEN BLAME RAILROADS

"There are many reasons why the weights of coal vary between the originating scales and the destination. In the first place, there is tolerance, which is the difference in weights due to variation in scales or weighing which may be permitted without correction of the waybill weight. The allowance made on coal is usually 1 per cent of the lading with a minimum of 1,000 lb. (450 kg.) on coal, although many railroads add 0.5 per cent for evaporation, making the total tolerance 1½ per cent to 2 per cent. Where large volumes of coal are involved it can easily happen that there will be a discrepancy of considerable magnitude because of this variation in scales.

"Secondly, losses of coal occur in transit. One of the principal factors in this connection is the requirement

of the railroads that the maximum amount of coal be placed on each car. Coal people are willing to co-operate with the railroads in this matter to a reasonable extent. The railroads, however, have such rigid instructions that it virtually takes a stonemason to build up the top of a car of coal to meet their requirements.

"Then the coal is switched in railroad yards over humps or gravity tracks. During switching operations the coal cars run down the hill at a considerable rate of speed, colliding with other cars standing on the track, with the result that much coal is frequently shaken from the top of the cars. The coal remaining adjusts itself to a new level, and by the time a car gets to its destination it has a very even top. To the eyes of an observer the car has not suffered any loss in transit. Naturally much of this loss is not reported. It frequently occurs during the night, and in such cases the coal is never gathered up. It can be easily understood how 500 lb. (230 kg.) of coal could be lost in such a manner.

"The next large source of loss is the defective equipment of the carriers. This causes small amounts of some kinds of coal and large quantities of mine-run and slack to be lost enroute. Sometimes the car will leak over the entire route. The leak is not large enough to cause a pile of coal to accumulate, but while the car is moving it is constantly losing part of its contents.

"There are also losses due to theft, although that has, in my opinion, been reduced to the minimum except in cases wherein railroad employees are involved and where the coal is taken for cabooses and switchmen's shanties.

"Discrepancies in weight, although no loss exists, often occur in connection with the failure of the railroads to remove iron ore and other material from cars before placing them at coal-mine tipples. This is particularly true at this season of the year, when snows fall on the car between the time it leaves the point at which ore, brick and such other material are unloaded and the time it arrives at the coal mine for loading with coal. This is a prolific source of loss and discrepancy.

"There are other conditions which cause loss of coal in transit, but these are the principal ones. All of these matters have been taken up with the Railroad Administration in an effort to have changes made which will insure the same amount of coal reaching destination that starts from the mines.

WHAT COAL USERS SHOULD DO

"The consignee of coal should take active steps to see that the railroads are required to pay for any losses which are indicated when comparison of the scale weights at originating scales and the destination weights is made. That it is the duty of the carrier to furnish proper equipment is unquestionable. Outside of the fact that it is to protect his own property, the shipper has no interest in putting equipment in shape for loading. Carriers will pay claims for loss due to the use of defective equipment, but will not reimburse shippers for repairs made to equipment to place it in proper condition for loading. Nevertheless, many coal producers maintain repair forces for this purpose. Freight Claim Association Rule 64 reads in part as follows: 'Cars shall be inspected by carrier furnishing the equipment before each loading.'

"On page 4,907 of the *Proceedings* of the Freight Claim Association at its twenty-fifth annual convention, held at Chicago, June 19, 20 and 21, 1917, it is recorded that Mr. Baskerville of the Norfolk & Western Railway Company, which is one of the largest coal-loading roads in the country, stated: 'One of the largest items in our loss and damage department is on account of the use of defective equipment. As a usual thing the claims paid are very heavy, and they are claims which could easily have been avoided.'

"Decisions of the Interstate Commerce Commission in regard to the maintenance and furnishing of proper equipment for loading are numerous; for example, Interstate Commerce Commission, 5,924—Wabash Sand & Gravel Company vs. Vandalia Railroad Company et al.; I. C. C., 3,820—Balfour, Guthrie & Company et al. vs. Oregon-Washington Railroad and Navigation Company; I. C. C., 4,829—Southwestern Missouri Millers' Club vs. St. Louis & San Francisco Railroad Company et al. In these three decisions it is clearly established that it is the primary duty of the railroad to furnish equipment that is usable.

"The National Coal Association has endeavored during the past year to have new rules prepared which would insure a better arrangement in connection with freight claims. The real necessity, however, is not for any arrangement which will give remuneration for losses, but to prevent in every way the losses which cause claims to be placed. I maintain that the railroads are far from perfect in their present arrangements for taking care of coal producers and receivers and that anything which is done to make an improvement in present situations should be through common action with the railroads.

"Electrical associations might very well take this matter up with the American Railroad Association and have this body appoint a special committee to co-operate with producers and receivers of coal on this subject."

Mr. Callahan's letter outlines the problem and suggests a practical remedy. That managers of electrical properties and secretaries of live electrical associations will be quick to act on his suggestions seems likely. Any action that will save 8 per cent of the coal or even 2 per cent of the coal used by central stations will be considered work of prime importance.

FOR *ten years there has been little development upon our streams of their power possibilities. And yet there has been increasing demand for power. No other country has such an undeveloped resource, and in no country has there been so great an apparent indifference during the decade to such work. The reason is that the Government itself did not wish to make improvements and private capital would not put itself at the caprice of the Government for building on the basis of revocable permits. Moreover, it was a matter of large expense, great worry and dealing with several departments to secure even such permits. The answer has been found in a bill by which the commission is created composed of the Secretaries of War, Interior and Agriculture, with jurisdiction over navigable waters, public lands, and forest reserves, which may lease such lands for 50 years and reasonable guarantee to the government and the lessees. This measure is now in conference, having passed both Houses of Congress, and will doubtless be a law in a few weeks.*—FRANKLIN K. LANE, *former Secretary of the Interior.*

Analysis of Insulator Practice—III

More Than Forty Transmission Companies Give Their Observations Regarding Failures at Dead-Ends and at Different Positions in String—Effect of Temperature Change and Deposits on Insulators—Methods of Preventing Trouble

PRACTICES of over forty transmission companies in equipping their lines with insulators, together with the nature, frequency, expense and effectiveness of tests and inspection, were discussed in detail in the last two issues of the ELECTRICAL WORLD. In addition a list of observed causes of insulator failure was given, the causes being stated in order of occurrence. In this issue some of the causes will be considered more in detail, and methods of preventing trouble or protecting insulators will be outlined. Space does not permit repeating company names so that key numbers given opposite the companies listed in the March 6 issue are substituted.

Dead-End Failures.—Dead-ends have been considered such vulnerable positions for so many years that data have been collected on whether insulators fail more at dead-end points than at intermediate points, the probable causes, and remedies. Most of the companies report that dead-end positions are more vulnerable and that the cause is either the greater mechanical load carried or the greater exposure to temperature changes. Failure at dead-ends has been reduced considerably by some companies (7, 8, 9, 20, 33) by using porcelain in compression instead of tension, or by employing cushioned joints and units in multiple.

Failure Next to Line Wire.—Since the electrical stress across an ungraded string of insulators is always greatest[10] across the unit next to the line wire, all the companies listed in Table I were asked if disks in this position failed more, and, if not, where greatest failure was noted. It was rather surprising to hear that practically all (except companies 11A and 14) say that this position is no more vulnerable, indicating that electrical stresses have little to do with insulator failure, at least at the operating voltages referred to. Several (11, 21, 34, 38) reported that the disk next to the cross-arm fails oftener; some attribute this to greater exposure to sun and rain. Others held that the position had no effect. Company 11 said that the line units fail most often, those next to the support next, and intermediate units least of all.

Alternate Exposure to Heat and Cold.—Practically all of the companies commenting on this subject say that experience proves it to be a serious cause of insulator deterioration. The observed result is that surface cracks form and absorb moisture. The tops of pin insulators also crack off squarely owing to fast contraction of tie wires and cracks appear under the caps of disk insulators. The latter trouble may possibly be relieved by introducing an elastic medium between the metal and the porcelain. Trouble from this cause is experienced principally after a cool or cold night, when the sun strikes the insulators, or when rain falls on insulators that have been subjected to the sun's rays for some time (company 14). One company (40) experiences the highest insulator depreciation in places where the units are alternately exposed to sun and fog several times a day. With pin insulators company 40 has used pipe pins with lead threads with greatly improved results over what were obtained with cemented iron thimbles. Replacing with heavier porcelain is suggested as a remedy by another company. Puncture failures due to cyclic temperature changes seem to be independent of position in string, says company 35. Some companies are quite optimistic, however, saying that they believe the newer types of insulators will better withstand rapid temperature changes.

Exposure to Dust and Ocean Fogs.—Some companies whose line insulators are exposed to smelter fumes, cement dust, ocean fog, or the like, have serious trouble, while others do not. For instance, company 3, which is near the ocean, has no trouble due to fogs, whereas company 35 and others have. A résumé of the experiences reported is given:

(4) Fogs cause trouble but do not interrupt service; pins have to be replaced where flash-over occurs.

(7) Cement dust causes flash-over when wet; frequent cleaning helpful.

(8) Causes surface leakage; not eliminated by cleaning.

(11A) Insulators exposed to acid or alkali washed regularly.

(12) Insulators exposed to chemical fumes cleaned monthly.

(14) Dew hardens cement dust, which must be removed with acid frequently.

(16) Cement dust washed off by frequent rains.

(21) No trouble from sulphur fumes.

(22) Dirt has caused trouble inside; insulators cleaned periodically.

(24) Trouble near gas plants and cooling towers eliminated by extra insulation and weekly cleaning .

(30) Substitute insulation with longer leakage surface.

(32) Trouble avoided by careful inspection.

(33) Clean insulators at railway crossings every six months with oxalic acid; use of three extra disks avoids necessity of cleaning.

(34) Cement dust causes no trouble, but ocean fogs cause temperature effects and salt deposit; wiped twice yearly to prevent pole burning due to surface leakage.

(35) Ocean spray sometimes makes lines inoperative, even several miles inland, by depositing salt on insulators; especially troublesome opposite steep beaches; fogs cause trouble after insulators have become badly coated with dust, salt, etc.; periodic washing and over-insulation helpful. Over-insulation will delay failure by flash-over but not prevent it, for, regardless of degree of over-insulation, fogs in early winter deposit moisture on cool parts and make lines inoperative.

(36) Fogs cause trouble only after insulators have become badly coated with dust, salt or the like; salt deposits also cause excessive leakage after drizzing rain; remedy is substitution of higher voltage insulators and washing periodically at especially affected spots.

(37) Wash insulators exposed to dust.

(38) Crusts of cement dust, salt from ocean fogs and sand cause serious trouble that is alleviated by washing and wiping insulators frequently.

(39) Ocean fog causes flash-over if insulator is dirty, but can be prevented by washing insulators and over-insulating lines where fogs occur.

(40) Cement dust causes excessive surface leakage which may lead to flash-over and must be wiped from insulators, where exposed, about every six weeks. The insulator is then wiped with a thin film of oil to prevent the cement dust setting; this treatment is effective for a limited period of four to six weeks. Where insulators are exposed to ocean fogs they must be wiped at intervals of thirty to a hundred days if flash-overs are to be avoided.

[10] See ELECTRICAL WORLD, Jan. 24, 1920, article by F. W. Peek, Jr.

St. Croix Falls Minnesota Improvement Co.

Patrolman's Daily Transmission Line Report

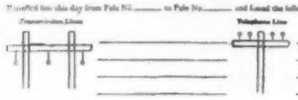
No.

Station _____ Date _____ 19__

State of Weather / Temperature: 7 A. M. ____ Noon ____ 6 P. M. ____

Patrolled line this day from Pole No. ____ to Pole No. ____ and found the following:

Transmission Lines / Telephone Line



Pole No. ____ on East Line ____ Tower No. ____ On West Line

(Insert Yes and strike out No in Blanks)

Other help hired (State why and for what) ____ Hours ____

Names	Kind of Work	Hours	Rate of Pay	Total	Remarks

Single transmission, marked ____ A ____ Top ____ Tie ____

Double " " ____ " ____ " ____

No. 2 " " ____ " ____ " ____

Material Used _____

Signed _____ Foreman

TRANSMISSION LINE PATROL REPORT

PUBLIC SERVICE COMPANY OF NORTHERN ILLINOIS

Line No. _____ Patrolled from _____ to _____ Div. _____ Date _____ 191__

Insulator ___ to be replaced at the following locations:

	ON WHICH STREET OR ROAD	POLE NUMBER OR LOCATION	TYPE OF INSULATOR	ON WHICH PIN	WHAT DO YOU THINK CAUSED INSULATOR TO BREAK
1					
2					
3					
4					
5					
6					

Other repairs to be made:

Cross arms or pole damaged at _____

Trees should be trimmed at _____

Other defects _____

Disconnecting switches No's _____ were inspected ___ operated ___ (clean or lubricate)

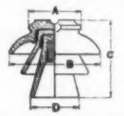
Patrol was made on foot ___ horse and rig ___ automobile _____ Patrol was completed at _____ P. M.

DATA ON PIN TYPE INSULATORS

No.	MAKE	TRADE-MARK	A	B	C	D
408A	Locke 408A					
311	Locke 311	Victor	5½	10	7	4
103	Westinghouse	Pittsburgh	6¾	7¼	7¾	4½
9412	Ohio Brass	O. B. or OB	5¾	8¾	7¾	4½
3005	Thomas		5½	8¾	7¾	4½
3512	Locke		5½	8¼	6¾	5
3400	Locke		5¾	11	—	7
3006	Thomas		6	11	9¾	5¾
5223	Locke		5¾	9	8¼	5¾
5520	Locke		5¾	8¼	7¾	5¼

NOTE

These dimensions are given for the purpose of identifying the insulators



DATA ON SUSPENSION TYPE INSULATORS

274	Locke Strain Insulator No. 3020 or 274
215	Westinghouse Strain Insulator
2285	Locke Strain Insulator

REPORT OF REPAIRS OF TRANSMISSION LINE

Insulators reported defective on reverse side were replaced on _____ 191__ A. M. P. M.

Permanent repairs to crossarms, poles or wire were made _____ 191__ A. M. P. M.

IMPORTANT DETAILS TO BE GIVEN

Line Wire or Ground Wire—

Which wire was broken, top line or which pin? _____ Type of tie? _____ Cause of break?

Was line wire broken in center of span? _____ or at insulator? _____

Was cross section of wire reduced due to drawing out? _____ Did broken wire or other metal work show signs of arcing? _____ Material of wire? _____

Insulators and Pins—

What type of insulator (see dimension drawing)? _____ on which pin? _____

Was insulator punctured? _____ Had it flashed over? _____ Was it damaged? _____ Cause? _____

Was insulator on a grounded pin? _____ Was pin damaged? _____ Was crossarm damaged? _____

The above questions indicate information which should be reported below.

The above form must be used, not only to report re... made on transmission lines.

...man, but also to report all repairs

Noted _____ 191__

System Operator

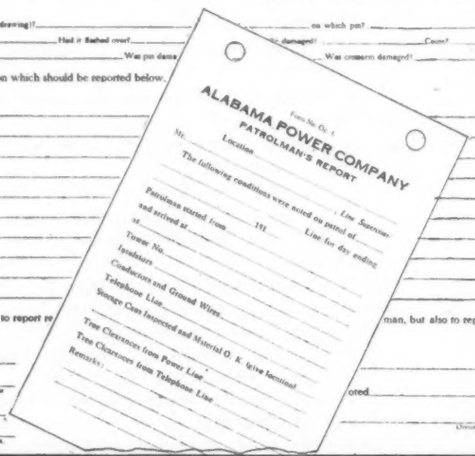
Line Foreman

Received _____ 191__

...oted _____ 191__

Eng. Elec. Dist.

Division Superintendent



ALABAMA POWER COMPANY

Form No. Ch. 1

PATROLMAN'S REPORT

Mr. _____ Line Supervisor

Location _____

The following conditions were noted on patrol of _____ Line for day ending _____

Patrolman started from _____ 191__ and arrived at _____ at _____

Tower No. _____

Insulators _____

Conductors and Ground Wires _____

Telephone Line _____

Storage Cam Inspected and Material O. K. Wire Identified _____

Tree Clearances from Power Line _____

Tree Clearances from Telephone Line _____

Remarks: _____

Report No. 50

TRANSMISSION LINE — INSPECTION REPORT

_____ Line

_____, Inspector Date _____

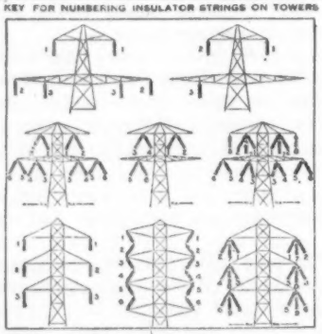
Inspector will report below in detail all matters requiring attention and indicate insulator trouble by marking O on diagram covering the defective unit.

LOCATION TOWER NO.	TIME	REMARKS

MARK DIRECTION OF VIEW O THUS

N — S — E — W

KEY FOR NUMBERING INSULATOR STRINGS ON TOWERS



REFERRING TO ABOVE DIAGRAMS NOTE:—

Always record position of insulator strings on the tower with back towards source of supply. Arrows point away from Niagara. In case of line anchor and transposition towers the insulator strings on the side of the tower marked Nos. (Niagara) and numbered 1, 3 and 5 shall represent the strain units on the Niagara side of the tower.

On line anchor and transposition towers which have double strings of units in each position the right hand string of the pair shall be designated by 1a, 2a, 3a, etc., depending on the position of the pair, and the left hand string shall likewise be designated by 1b, 2b, 3b, etc.

On transposition and other special tower arrangements the vertical insulator strings shall be numbered 7, 8 and 9 and on special towers where all strings hang vertically they shall be numbered from top string downward. Insulator units shall be numbered from tower to cable.

Key for recording different makes for units used

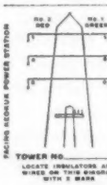
HERMSDORF CO. 11"	A	O. B. 11" Standard Type	O
LOCKE CO. "	O	O. B. 10" " "	S
CANADIAN PORCELAIN, Strain Type 1		O. B. Keokuk Type	S
CANADIAN PORCELAIN, Susp. Type 2		O. B. Sanitary "	Z

MISSISSIPPI RIVER POWER CO.

KEOKUK—ST. LOUIS TRANSMISSION LINE

PATROLMEN'S DAILY REPORT

_____ STATION. DATE _____ 191__



WEATHER A. M. _____ P. M. _____

DIRECTION OF WIND _____

TEMPERATURE: 7 A. M. _____ 12 M. _____ 6 P. M. _____

ON DUTY TODAY AT _____

I HAVE THIS DAY PATROLLED FROM TOWER NO. _____ TO TOWER NO. _____ AND FOUND _____

TOWER NO. _____

LOCATE INSULATORS AND WIRES ON THIS DIAGRAM WITH X MARK

DATE ABOVE TROUBLE WAS _____

TELEPHONE TROUBLE ON THIS DIVISION _____

REPORTED TODAY

FROM			
TIME			
FROM			
TIME			

ANY EXTRA EXPENSE _____

MEALS _____

TEAMING _____

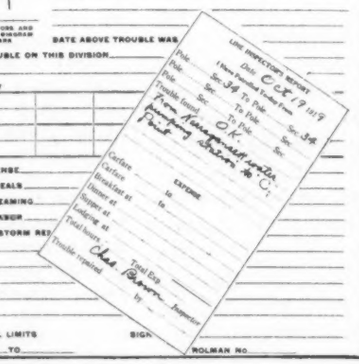
LABOR _____

LIGHTNING AND STORM REPAIRS _____

REPAIRS MADE _____

REGULAR PATROL LIMITS

TOWER _____ TO _____ SIGN _____ ROLMAN NO. _____



Line Inspector's Report

Date Oct 19 1919

I found trouble from No. 34 To Pole No. 35 To Pole No. 36

Trouble found from Insulator No. 1 Cr.

Put on new Insulator O.K.

Chas. Peterson Inspector

Total Exp. _____

By _____

HYDRO-ELECTRIC POWER COMMISSION

INSULATOR TEST REPORT

Section _____ No. of Test _____ Tower No. _____

	TEST RECORD									REPLACEMENT RECORD								
	Position of string on tower									Position of string on tower								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

For Key and instructions see back of sheet.

No. suspension units on tower _____ No. Bad _____

No. strain units on tower _____ No. Bad _____

Remarks _____

Tested by _____ Replaced by _____

Date _____ Date _____

TRANSMISSION LINE REPORT FORMS

Left top—Records for some lines kept on cards, others on form reproduced (Northern States Power Company). Right top and left center—Opposite sides of form used by Public Service Company of Northern Illinois. Superimposed form—Patrolman's report submitted to division office with additional comments directly to line superintendent. (Alabama Power Company). Right center—No report made unless flaw is found (Eastern Massachusetts Electric Company). Left and right bottom—Opposite sides of insulator test report made in duplicate by Hydro-electric Power Commission of Ontario. Center bottom—Patrolman's daily report (Mississippi River Power Company). Superimposed form—Half of double post card, one part of which is mailed to general superintendent and other to chief operator; latter notifies district superintendent, who is held responsible for changes or repairs. (Central Maine Power Company.)

(X) Insulators exposed to cement dust wiped every two weeks; extra heavy insulation used.

Preventing Injury from Arc-Overs.—Flash-over of an insulator is really the opening of the safety valve, comparatively speaking; but if it is followed by a power arc, injury often results to the insulator. To avoid trouble from this source many companies (7, 8, 9, 21, 22, 24, 29,[11] 30, 31, 33, 37, 38 and X) provide arcing horns on their insulators.

Company 37 says: "Judging from the fact that no insulators have been damaged by flash-over, the horns are apparently 100 per cent perfect, but it is not certain that flash-overs have occurred." Company 40 has tried arcing horns on suspension insulators to reduce injury to insulators and wire from flash-over, but has not found them very effective. On the other hand, company 38 has found them very effective on 150,000-volt lines. This company's experience with horns on 60,000-volt lines has not been extensive enough to warrant any conclusions yet. Other companies (2 and 12) over-insulate to prevent flash-over, while companies 11, 30 and X interrupt the power after flash-over temporarily by means of a Nicholson arc suppressor or reduce the voltage temporarily to prevent damage. One-half minute is allowed by company 30 after a flash-over on its 110-kv. lines before re-energizing the line to permit the insulator to cool sufficiently. This practice does not interrupt service because duplicate lines are used. Company 11 says that arcing horns are used on 50 per cent of its lines to protect the cables. They have no appreciable effect on the insulators. Heavy insulators that will not be easily damaged by the arc heat are used by company 4. Several companies state that the surface of insulators are blistered by a flash-over and collect moisture and dust more easily, although company 29 says the glaze on the newer insulator is not affected to great extent. Therefore companies 20, 30, 40 and X remove insulators after a flash-over. Extra-long pins are used by company 3 to prevent trouble from flash-over. Companies 10, 11 and 31 say that trouble from this cause is rare.

Very few companies have reached the stage of insulator investigation where they plot the percentage of insulator failures against the years of service. The reports run about as follows, the figure in parentheses being in every case the company number:

(1) Four to 9 per cent fail after fifth year for pin and disk respectively.

(2) Eight years' average life.

(8) Beginning in 1915, two years after completing its 43-mile double-circuit 66,000-volt transmission line, this company tested with a megger about 50 per cent of the 15,696 insulators then installed, classifying them as to position (*i.e.*, dead-end or straight-line) and according to type. Every year since then it has made similar tests, just recently substituting the "buzz-stick" for the megger. Over 30,700 insulators were in service in 1918. In all except two tests out of fourteen the percentage of faulty dead-end units was greater than the defective straight-line units, ranging from thirteen to one to about one to one. No type seemed to have any definite rate of depreciation, the percentage removed each year departing considerably from any average depreciation curve. Two types showed no depreciation after two years of service, whereas one type showed as high as 38 per cent for dead-end positions. The data did indicate very clearly, however, which types were unsuitable and also indicated that such records should be kept permanently. As a result of these tests the use of three types of insulators was discontinued.

(9) Four years' average life for old-type units and six to eight years for new units with cushion between pin and porcelain.

(10) Pin insulators rated at 30,000 volts installed in 1903 gave trouble in 1910 to 1912.

(11) Fifty-one per cent of 22,000 type A insulators failed in nine years. None of 11,000 type B units failed in five years.

(11A) After four years of service about 12 per cent of all insulators tested weak, the next year about 10 per cent, the next year 8 per cent and the seventh year about 5 or 6 per cent. Not much difference was noted between different types.

(20) Pin-type start to fail after two years; no failures in three and one-half years with suspension insulators.

(29) In 1918 less than 2 per cent of 400,000 insulators failed in service or under test, and in 1919 less than 1 per cent; some pin insulators installed in 1907 still in service; some link insulators installed in 1910 still in service; other insulators have shown rapid deterioration; units of last three years show remarkable improvement.

(30) Four and six-tenths per cent showed fault on test and 1 per cent punctured in six years.

(31) Ten to 25 per cent a year fail at end of ten years.

(33) The cap-and-pin disk insulator in strain has an average yearly mortality of 2 to 5 per cent, whereas the same unit in suspension has a mortality of only 0.5 to 2 per cent. Pin insulators are more erratic than disk type. Some 22,000-volt pin insulators have been in service since 1915 with less than 0.5 per cent becoming defective, whereas two lines which have been in service only three years have lost 28 per cent.

(34) Six years in service.

(36) A 75-mile, 60-kw. line was salvaged in 1917 after ten years of service, and the pin insulators (Locke 341) were installed on another line. Except for those units injured in transit, these old units are holding their own with insulators which have been in service a much shorter time. On another line 30 per cent of 75,000 disk insulators installed in 1912 failed after five or six years.

(37) Sixty-thousand-volt line has been in service over sixteen years and insulator failures have been negligible.

(38) Has compiled some elaborate data on percentage of defective insulators found after various lengths of service, but no specific law seems to be followed. For instance, on one of its 150,000-volt lines the percentages of defective insulators found after twenty-eight, thirty-nine, forty-four and seventy-one months of service were 1.6, 2.9, 12 and 1.3 respectively, while on several 60,000-volt lines the percentages of defective insulators found after twenty-eight, thirty-eight, forty-eight, fifty-eight and seventy-two months of service averaged 5.75, 7, 8, 7 and 8.25 respectively. In all cases, however, a higher percentage of dead-end units was found defective than of suspension units—from two to six times greater.

(39) Insulators purchased and installed within the last ten years, made under modern manufacturing conditions and methods, have shown no signs of deterioration. Some insulators which were installed twenty years ago are still giving exceptionally good service. Other insulators of identically the same dimensions and shape have given continued trouble since being installed. All were manufactured before 1905 and many installed with cemented-in metal pins. Signs of electrolytic corrosion have been evident, which has resulted in severe mechanical stresses that may have been the cause of some failures, although inferior porcelain and workmanship was the general cause.

(40) Four-part pin insulators in service about fifteen years show approximately one-third of the insulators with one or more defective parts. In some sections, however, the number of defective parts is not more than 5 per cent of the total number of parts. Suspension insulators made prior to 1914 show about 20 per cent depreciation to date.

(X) Maximum life, twelve years; average life, eight years; 70 per cent of 86,000 units installed in 1913 still in service; much longer life indicated by new units, only 10 per cent of 38,600 installed in 1915 having been found defective so far.

[11] Used in some cases; effectiveness not known because of other steps taken to prevent trouble, such as use of different insulators and improved testing methods.

Electric Service in Illinois Coal Mine

Typical Installation and Distribution Features of Coal Mine Service Shown in Installation of Union Colliery Company at Dowell, Ill.—Energy Consumption About 4 Kw.-hr. per Ton of Coal Mined

By H. W. EALES

Chief Electrical Engineer Union Electric Light & Power Company, St. Louis, Mo.

THE coal-mining industry has certain power requirements which are typified in the service supplied by the Central Illinois Public Service Company to the Union Colliery Company. The capacity of the installation is not the important feature but rather the method of handling the distribution problem of an average-sized mining property supplied by central-station power. It is also of interest to note that the energy consumption of this company has been found to be approximately 4 kw.-hr. per ton of the coal that is mined.

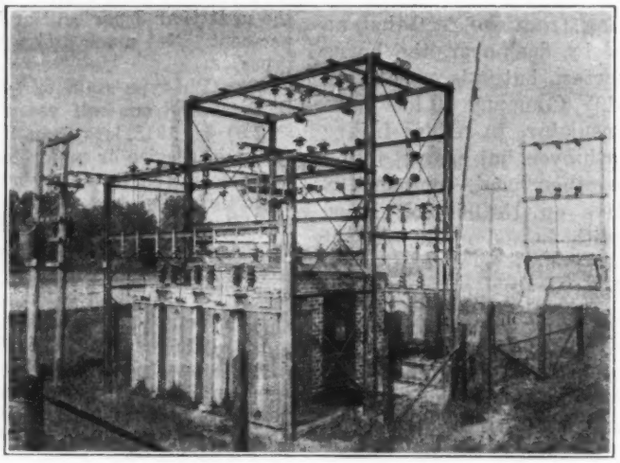


FIG. 1—TYPE OF CONSTRUCTION USED FOR OUTDOOR SUBSTATION SUPPLYING COAL MINE

Energy is delivered at 33,000 volts, three-phase, 60 cycles, to a semi-outdoor type of substation. As shown in Fig. 1, a structural steel tower is used for dead-ending the transmission line and to support the various buses, disconnecting switches, etc. The 33,000-volt metering equipment and main oil switch are installed in a small brick house constructed within the base of the tower. Three 333-kva., single-phase, self-cooled transformers, with one additional spare unit, transform the 33,000-volt supply to 2,200 volts. This equipment is protected by a three-phase, 33,000-volt electrolytic lightning arrester. Meters are inserted in the 33,000-volt side by the company supplying power, and each distributing circuit is metered to check the power used in the various operations.

From the outdoor substation bus energy is transmitted at 2,300 volts by No. 4/0 three-conductor lead-covered cables in 3½-in. (8.9-cm.) fiber duct laid in cement to the air shaft, approximately 40 ft. distant, and the main shaft, approximately 400 ft. (122 m.) distant.

Within the air-shaft hoist house the principal distributing switchboard has been installed as shown in Fig. 2. From the line diagram of Fig. 3 it will be seen that from this board are handled four power circuits and a lighting circuit, namely, 2,300-volt circuit to air-shaft hoist motor, 2,300-volt circuit to 200-kw. motor generator set, 2,300-volt circuit to mine bottom, temporary 230-volt circuit to ventilating fan, and a 2,300/230-volt lighting circuit for lighting the town of Dowell.

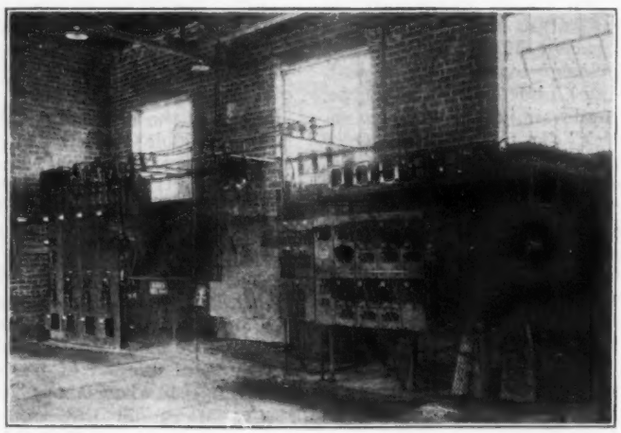


FIG. 2—SWITCHBOARD AND HOIST-CONTROL EQUIPMENT IN AIR-SHAFT HOIST HOUSE; SLIP REGULATOR IS NOT SHOWN BUT IS AT RIGHT OF CONTROL PANEL

At the main shaft house power is supplied from the 2,200-volt outdoor substation bus through distributing panels to the motor-generator set for the main hoist and to a 150-kva., 2,300/230-volt, three-phase transformer which supplies power to various motors on the tipple.

In the mine proper there are two distribution systems—an alternating-current system for coal-cutting machines, pumps, lights, etc., and a direct-current system for haulage. The alternating-current energy is transmitted to the mine at 2,300 volts by means of a No. 0 three-conductor steel-armor and lead-covered cable. This cable is carried down the shaft on substantial wooden cleats fastened to 6-in. x 6-in. (15-cm. x 15-cm.) timbers spaced 4 ft. (1.2 m.) apart and terminates in a special high-pressure-type pothead which is compound-tight and capable of withstanding the hydrostatic pressure of the 300-ft. (91.5-m.) head.

This 2,300-volt incoming feeder terminates in the mine substation, which is situated at the bottom of the air shaft. Referring to the line diagram, it will be noted that a distributing bus feeds two outgoing cables, each protected by an automatic oil switch as shown. These cables are also of the steel-armored type, and each is carried buried in a trench in an air course to a transformer vault. In each transformer vault is installed a 150-kva., 2,300/230-volt, three-phase oil-cooled transformer, the secondary of which is connected solid to a local No. 4/0 distribution network for supplying power to the coal faces. This secondary network wiring is run open and supported on thimble insulators mounted on wooden mine props. This wire can readily be taken down and moved to other locations as the working faces move outward. As the working faces progress away from the source of power, the 2,300-volt cables are extended and the transformer moved to a new distributing center. Under

present operating conditions the transformers are used to supply a local secondary area of approximately 1,000-ft. (305-m.) radius.

Provision has been made in the mine substation for the addition of a number of such 2,300-volt distribution cables and for one or more incoming feeders from the surface substation.

Direct current for mine locomotives is supplied by a 200-kw., 275-volt motor-generator set in the air-shaft hoist house and is carried to the mine down the air-shaft by 900,000-circ.mil., 500-volt paper-insulated, lead-covered cables, one of the same size being used for the return. This cable also terminates in the mine substation on a bus which supplies two circuits feeding in opposite directions, each circuit being protected with a 400-amp. automatic reclosing-type circuit-breaker. The No. 2/0 trolley system is sectionalized into two groups, each group being protected by one of the reclosing circuit breakers. As the mine develops it is planned to install mine substations with converting equipment operating at 2,300 volts alternating current for supplying direct-current power to the haulage system.

Trolley-type 6-ton, 250-volt locomotives are used in the haulage work although a 15-ton machine is soon to be added. Mining machines are of the short wall type rated at 30 hp. (one hour, 55 deg. C.), operating on 230-volt, three-phase current. Fig. 4 shows one of these machines in operation and will give an idea of the conditions these machines must operate under.

Power requirements on the surface are divided mainly into that required for hoisting and that required for the tipple. Hoisting at the Kathleen mine is done at the main shaft and at the air shaft.

The main shaft hoist, as shown in Fig. 5, is operated by a 600-hp. (40 deg. C. continuous rated), 235-r.p.m., 500-volt shunt-wound, direct-current motor, which is connected to the pinion shaft of the hoist drum through a Francke type flexible coupling. Power for the motor is supplied by a four-bearing, 900-r.p.m. flywheel-type motor-generator set of the following specifications: Motor, 500 hp., 2,300 volts, three-phase, 60-cycle, wound-rotor-type; 20,000-lb. (9,000-kg.) flywheel, 92-in. (2.3-m.) diameter, riveted-steel plate type. The power input to the flywheel set is limited by an automatic liquid slip regulator, which is self-cooling. The flywheel when operated normally has sufficient stored energy to complete any given hoisting operation.

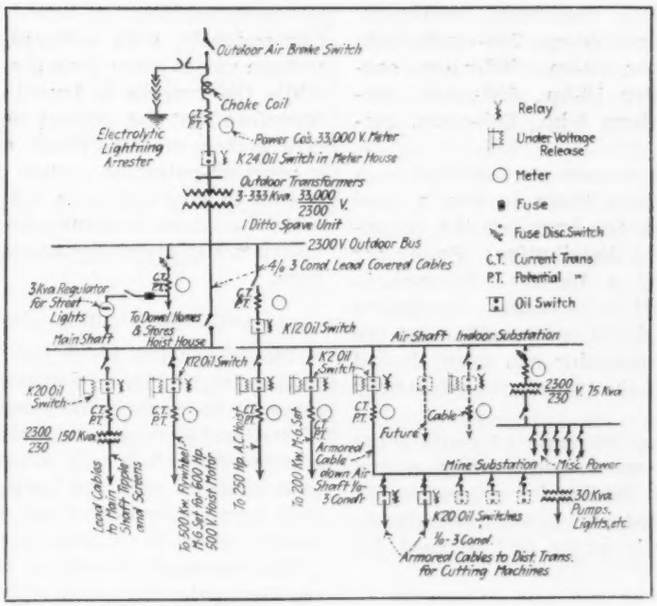


FIG. 3.—LINE DIAGRAM OF COAL-MINE POWER DISTRIBUTION

The speed control of the hoist motor is operated on the familiar Ward-Leonard-Ilgner system. The motor speed is changed by varying the voltage of the separately excited generator. Direction of rotation is changed by reversing the field excitation of the generator. All of these operations have been simplified so that the engineer performs them by moving his control lever forward or backward.

The cycle of operation for the 325-ft. (100-m.) depth vertical shaft is as follows: Acceleration, seven seconds; full speed running, fifteen seconds; retarding, five seconds; loading, nine seconds; total, thirty-six seconds.

Operating at this cycle the capacity is 5,000 tons in an eight-hour day.

The air-shaft hoist, which is used mainly for men and materials, is operated by a 250-hp., three-phase, 450-r.p.m. slip-ring induction motor. Speed control is obtained by means of grid resistances connected in the rotor circuit. While the main shaft tipple was being built coal was hoisted through the air shaft. In both of these hoists over-wind devices and track limit switches are in use.

Tipple motors are all of the inclosed ventilated type, galvanized air ducts being piped from the motor to a source of clean air outside the tipple. Power requirements

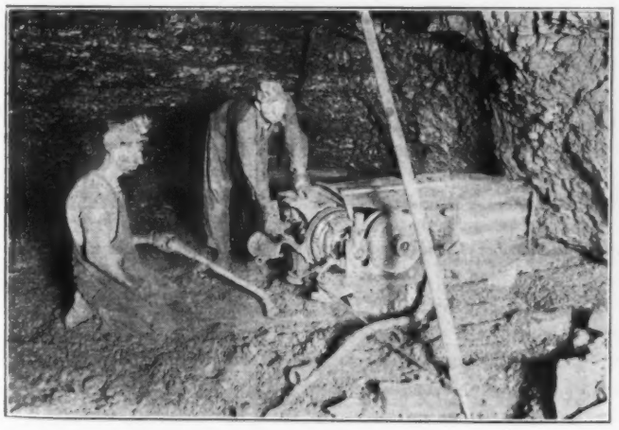


FIG. 4—SHORT WALL MINING MACHINE IN OPERATION (NOTE SEVERITY OF MOTOR OPERATING CONDITIONS)

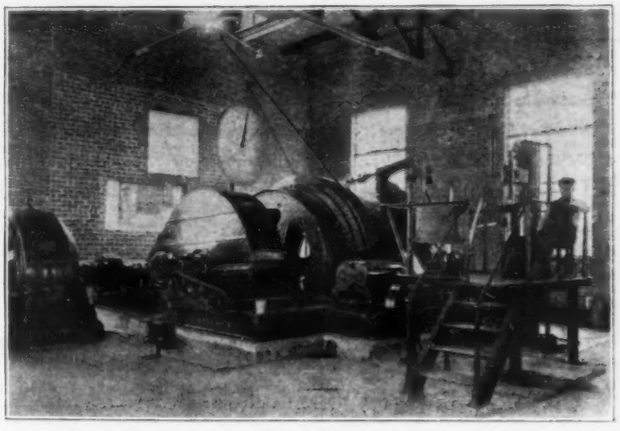


FIG. 5—MAIN SHAFT HOIST USING WARD-LEONARD-ILGNER CONTROL

for tipple work are as follows: One 20-hp., 600-r.p.m. variable-speed feeder motor; one 20-hp., 900-r.p.m. variable-speed shaker screen; one 20-hp., 600-r.p.m. constant-speed picking table; two 10-hp., 600-r.p.m. constant-speed gob conveyors; three 5-hp., 600-r.p.m. constant-speed loading.

The control devices for all motors are installed on a central control platform, where there is also a steel cabinet-type distributing box for handling the incoming 230-volt power supply and distribution. Power for these motors is supplied by a 150-kva., three-phase transformer in the main-shaft hoist house. By closing a push-button circuit at the distribution cabinet on the control platform the tipple operator can open the oil switch on the primary side of the transformer, instantly shutting off power.

The present ventilating requirements necessitate the operation of the fan at slow speed, and a 50-hp. wound rotor motor was installed as suitable for present needs. As the workings are extended and greater ventilation is needed a 250-hp., 2,300-volt motor will be used for the fan drive.

Characteristics of Different Street Lighting Systems

The Constant-Current Series, the Constant-Potential Series and the Constant-Potential Multiple Systems Compared

"SINCE all arc lamps with the exception of the luminous or metallic-flame lamp have been practically superseded by the gas-filled incandescent mazda lamp for street lighting, there is no longer the necessity for the constant-current circuit," said Dr. C. P. Steinmetz, in an address before the three hundred and fifty-seventh meeting of the American Institute of Electrical Engineers in Chicago. "However, the increasing number of incandescent lamps being installed on constant-potential series and multiple systems will still require high voltage distribution.

"Constant-potential circuits, other things being equal, are preferable to constant-current circuits for the operation of tungsten lamps because, unlike the carbon lamp, the tungsten lamp has a positive temperature coefficient. Consequently, with changes in circuit conditions the voltage varies more than the current in tungsten lamps, while the reverse is true in carbon lamps. It follows therefore that the current regulation on a constant-current system must be closer than that of the voltage on a constant-potential system if tungsten lamps are required to give the same life in each case." Dr. Steinmetz then gave a comprehensive discussion of the characteristics of street-lighting systems which is abstracted here.

DANGER OF SURGING PRACTICALLY ELIMINATED

The regulation which can be obtained by the use of modern regulators on constant-current systems is amply close for the successful operation of tungsten lamps, and if reasonable care is exercised the danger of surging hardly exists. It is only where tungsten lamps are operated in series with arc lamps that the life of the tungsten lamps may be reduced by surges due to an overloaded circuit or to maladjustments of the arc lamps.

The problem of voltage regulation is eliminated in constant-potential street-lighting systems, where the high-voltage series or multiple systems are supplied from individual transformers. This is because domestic lighting constitutes a large part of the load of the electric supply systems and the voltage regulation required for that service is satisfactory for constant-potential, series or multiple street-lighting systems.

The constant-potential series system is less flexible than the constant-current system in the number of lamps that can be used. However, the full number of lamps on a constant-potential series system can be reduced by the insertion of reactances and by changing transformer taps. The high voltage to ground is another disadvantage of this system. On the other hand, the constant-potential systems have the advantage of high power factor, high efficiency and that they can be operated from a transformer on a pole without special station equipment. Furthermore, with the constant-potential multiple system of distribution, the number of lamps is practically unlimited. When the street lights are tapped on to a general distributing system, however, it is a problem to turn the lamps on and off, and no satisfactory and economical device has been developed for that purpose.

A COMPARISON OF THREE TYPES OF STREET-LIGHTING SYSTEMS—C. P. STEINMETZ

	I Constant-Current Series System	II Constant-Potential Series System	III Constant-Potential Multiple System
1. Type of lamp	Arc lamp or incandescent lamp	Incandescent lamps only	Incandescent lamps only
2. Station apparatus	Constant-current transformer or reactor, etc.	None, Transformer on pole	None
3. Number of station circuits	A separate circuit for every lighting circuit	No special circuits from station	No special circuits from station
4. Number of wires per circuit	Single-wire circuit	Single-wire circuit	Two-wire circuit
5. Accessories at lamp	Film cut-out, or auto-transformer or series transformer	Auto-transformer or series transformer	Constant-potential transformer for one or more lamps
6. Size of circuits	Limited number of lamps per circuit	Limited number of lamps per circuit	Unlimited number of lamps per circuit
7. Flexibility	Great flexibility in number of lamps	Lesser flexibility	Great flexibility in number of lamps
8. Power factor	80 to 85 per cent with incandescent lamps, 70 to 75 per cent with arc lamps	95 to 99 per cent	Practically unity
9. Safety	High voltage at lamp except when using transformer	High voltage at lamp, except when using transformer	Low voltage at lamp
10. Switching	At station	Special	Special

Readers' Views and Comments

Hydro-Electric Nomenclature

To the Editor of the ELECTRICAL WORLD:

SIR: Referring to Mr. Tallant's letter on page 324 of the Feb. 7 issue of the ELECTRICAL WORLD, we agree thoroughly with him as to the desirability of adopting the uniform nomenclature embodied in the generic term "hydraulic turbine" and the subdivisions "impulse turbine" and "reaction turbine." We are heartily in favor of a uniform adoption of these terms as contrasted to the more or less ambiguous term "waterwheel." This latter term conveys an idea quite at variance with the modern design of high-grade units and we believe should be retained as applying more exactly to the small apparatus that Mr. Tallant mentions as well as to the overshot, undershot and breast types of apparatus which are purely waterwheels.

There is another aspect to the situation, however. It would be well to adhere to the first three terms mentioned above, but the fact remains that, according to present popular notions and usage, any rotating device that develops power from water will be automatically considered a waterwheel and undoubtedly will be so designated. This may change in time, but the change could be accomplished only after a considerable period of exclusive use of the other terms by the various interests that have need for them.

We are in accord with Mr. Tallant's views and are sure that practically all the hydraulic turbine builders in the country will take a similar attitude. The Pelton Water Wheel Company might reasonably be expected to be the only authority to object to the three terms in question, and Mr. Tallant's article strikes us as being very commendable.

M. H. WHITE,
Manager and Chief Engineer Hydraulic Department,
Allis-Chalmers Manufacturing Company.
Milwaukee, Wis.

Let There Be Light

To the Editor of the ELECTRICAL WORLD:

SIR: Reports from the most recent visitors to Bolshevist Russia are to the effect that the soviet system has broken down and that in its place the ruling powers have partly built and are planning to extend on a nation-wide scale a system of compulsory labor under militaristic discipline. It is doubtless as a part of this system that Lenine is dreaming of the great scheme of hydro-electric development to which editorial allusion was made in your columns a week or two ago. Such a vast undertaking would be utterly impossible under soviet rule, a plan of government suitable only to semi-civilized people—one that might conceivably endure in the interior of China or in Persia or Hindustan, were the natives of those countries to seize upon it as an avenue of escape from political serfdom, but which must wither in any land which Occidental breezes reach.

In the Russia of old an eternal conflict between Europe and Asia was waged, and it used to be held that as long as the peasants wore their shirts outside their trousers Asia would have the better of it. It may be that out of the welter of Bolshevism Europe will emerge the victor—not the autocratic, imperialistic, landlord-ridden Europe of yesterday, but the republican, forward-striving Europe that is slowly being born from the wreck of war. Certainly, if Russia is to be flooded by electric light and fortified with electric power by the efforts not of foreigners but of Russians themselves, shirts all over that land will be tucked inside the trousers. Let it be hoped that simultaneously "proletarian" tyranny will disappear, to be superseded by that system of representative democracy under which all modern political progress and all lasting social amelioration has been accomplished.

Brooklyn, N. Y. FRANK W. CHASE.

Barometric Pressure and the Metric System

To the Editor of the ELECTRICAL WORLD:

SIR: The high atmospheric pressure during the cold period prior to Feb. 7 was noted in the ELECTRICAL WORLD for that date. As we are all living near the bottom of a sea of air and this sea of air does not recognize national boundaries, it is preferable to record meteorological data in the international way, especially if that is the most convenient. The barometer reading given was 30.85 in. or 784 mm. At sea level about New York City the column of mercury rose as high as 790 mm. It will be seen that this manner of recording air pressure (1) requires no fractions of any kind, (2) is an international method, (3) represents a definite measurement, based on the international meter, and hence represents the same thing in all countries.

The British yard standard is a national standard only and renders the British mile, yard, etc., slightly different from the corresponding United States measures, which have been based on the meter since April 5, 1893. The large iron and steel company of China, the Hangyang Iron & Steel Works, has used only the metric weights and measures, and even the old measures of China have been redefined in terms of the metric standards. The Chinese word *ch'ih* officially indicates 32 cm. The *ts'un* indicates 32 mm. These differ from two corresponding measures in Japan and also from our foot and inch. All of these measures, however, in the United States, China and Japan are definitely defined in terms of the international meter. It seems obvious, therefore, that mutual understanding and convenience will be effected by use of the millimeter in recording barometric pressures.

The same advantages may be secured by the use of millimeters in recording the precipitation of rain and snow. During the snowstorm which began on Feb. 4, the precipitation was 4.45 in. or 112 mm., as recorded by the United States Weather Bureau at New York City. Not only is the millimeter a more convenient measure, but the use of such a measure will have a splendid educational value.

The metric weights and measures were legalized by the United States Congress for all transactions in 1866, and the Weather Bureau is at liberty to publish its data in the metric way and will probably be glad to do so.

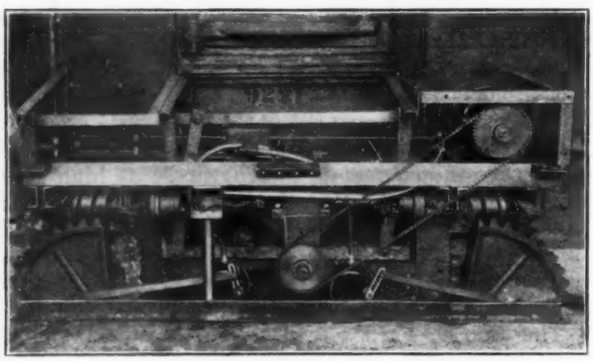
HOWARD RICHARDS, JR.
Secretary American Metric Association.
New York.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Electric Drive Found Satisfactory for Ash Dump

WITH compressed air available only a part of each day and all exhaust steam used to heat boiler make-up, the Buffalo General Electric Company decided that the best method to operate the mechanical dumping mechanism for its Westinghouse twelve-retort stokers was by means of electric motors, chain and worm drive. The mechanism shown in the illustration operates one-half of each stoker, there being duplicate equipment for operating the other halves. Each motor drives a short shaft parallel to it through a chain, this shaft,



ELECTRIC MOTORS USED FOR OPERATING POWER ASH DUMP

in turn, driving a cross-shaft through a worm and worm wheel. Two standard jaw clutches enable either the right-hand or left-hand dump section to be operated. This drive contains the usual shearing pin which forms part of the standard stoker, so that in case of binding the pin will prevent excessive stress on the mechanism.

An auxiliary panel is furnished with a double-throw switch for reversing the motor, one direction being for opening the dump and the opposite for closing. Limit switches are provided on each section of the dumping mechanism.

H. L. RAWSON.

Buffalo, N. Y.

Some Pointers for the Construction Crew Foreman

WHEN an electrical construction foreman measures his men by the amount of work they do, in the same manner as a foreman of ditch diggers, it will usually be found that the station operating records will later on show a series of interruptions due to carelessness in construction. Electrical apparatus is often of a delicate nature and considerable adjustments are necessary after the apparatus arrives in the field. For instance, when an electrician is detailed to mount and connect some oil switches, if he knows that the foreman wants a good job done and will not blame him unjustly if the time occupied is longer than expected, he will give the switches internal inspections, make adjustments, solder lugs and connect the operating rods or electrical control in such a manner that the switches will give excellent service for years. On the other hand, if he knows that the foreman will reprimand him for not making fast enough progress, he will not exercise the care that would insure a first-class job.

The present-day successful foreman will study his men and know their weak and strong points. For instance, he may have a man in the crew who has had some experience at blacksmithing and he can use this man for sharpening chisels and doing other jobs at the forge. Then he may have a man who takes pride in his ability to work on live wires, and if this man is intelligent and careful he is the logical man to use for such work. There is often carpenter work in connection with electrical work, and the foreman will usually find a man who is qualified along this line.

When there is rough work to be done and laborers are not available it may be a good idea for the foreman to give each electrician a share of the work. If the same man be kept at a disagreeable task for several days—for example, drilling concrete in cramped quarters in a hot generator pit until his hand becomes blistered—while others are exempt, jealously and accusations of partiality are pretty sure to arise.

L. W. WYSS.

Iron Mountain, Mich.

Battery Floating Voltage Should Be 2.12 to 2.14 Per Cell

SINCE storage batteries for emergency excitation of generators must perform a very important duty when called into service, every precaution should be taken to have them in readiness. To accomplish this, care in operating and charging is necessary. The first point to consider in operating is to keep the end-cell switch on

CELL VOLTAGE AND GRAVITY READINGS AT WHICH BATTERY SHOULD BE RELIEVED OF ITS LOAD

Rate of discharge (amp.)	1,000	1,570	2,000	3,000
Time limit at this rate (min.)	60	30	21	10
Amp.-hr. at this rate	1,000	785	700	500
Voltage per cell falls to	1.60	1.53	1.48	1.31

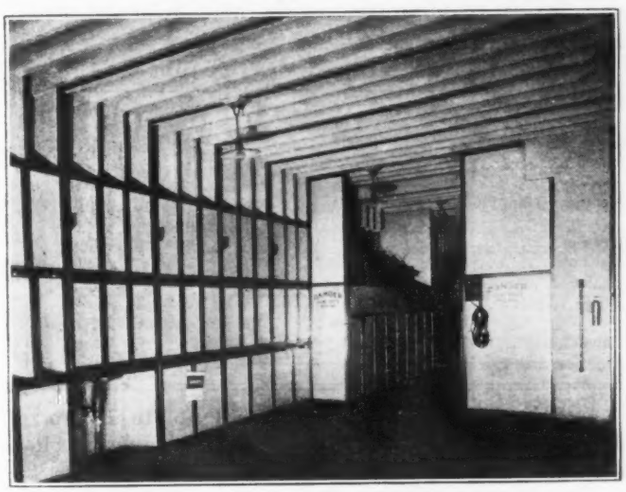
such a contact as to maintain a voltage of 2.12 to 2.14 across each cell when the battery is "floating" on the exciter line, so that energy does not pass to or from the battery although it is connected across the line in readiness to take up the load should the power supply fail. In such a case when the battery is called into use it should not be allowed to discharge after the voltage has dropped to a certain value. This limiting voltage together with the number of minutes taken to reach this condition for different rates of discharge are shown in the accompanying table for a battery rated at 1,000 amp.-hr. for one hour. These limits should not be exceeded, but in case of extreme emergency the battery may have to operate after they have been passed.

After a discharge the battery should be charged immediately in the same manner as the periodic weekly charge. In making this charge the normal current (156 amp. for the battery mentioned) is sent through the battery until the voltmeter and the hydrometer readings have been constant for one half-hour. After an over-discharge the readings should be constant for one hour. In case it is required to hasten the charging, it may be done at 130 per cent of normal rate until gasing starts, when the rate should be lowered to normal. If a lower rate must be used, the time of charge after the voltage and gravity are constant should be proportionately increased. Following a discharge, care must be taken in charging the end cells which were not discharging during the entire time. These cells must not be charged as long as the cells which are fully discharged. An indication of completion of charge of these cells is free gasing.

These instructions are extracted from a set of rules for use in the stations of the Pennsylvania Water & Power Company.

Barriers Increase Safety in Electric Station

THE use of more barriers in station construction was recommended to the National Safety Council by Walter C. Wagner of the Philadelphia Electric Company in a paper read before the public utilities section of that body. He pointed out that barriers are superior to warning signs in that they form a physical protection against thoughtless or accidental movements. No hazard is incurred through their deterioration, and equipment is easily inspected and is accessible for repairs and changes. Simplicity of arrangement of conductors and apparatus also serves to increase safety.



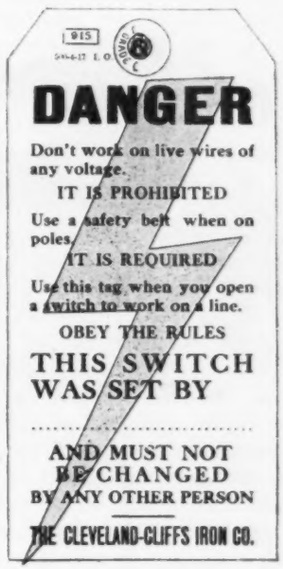
BARRIERS FOR FEEDER AND ARRESTER PARTS

Regarding barriers of concrete construction it must be noted that concrete is not in any sense an insulator, nor is it a good conductor. It serves to isolate live parts which are otherwise insulated, and it supports casings and frames which must be grounded by other means even though the concrete is reinforced with steel. Generally barriers should not support live buses or apparatus subject to stress from electrical disturbances.

The doors to fit in the opening between barriers should be small, light and rugged. They may be made with asbestos panels, clear wire glass in front of disconnecting switches, or heavy screen wire where heat radiation necessitates. A door with a spring-hinged panel is preferable on locked apartments in front of current transformers and oil switches where electrical breakdown might cause a sudden formation of gases.

Safety Measures for Protection of Linemen

IN THE interests of safety, iron and copper mining companies in the upper Michigan peninsula take the control of defective high-tension lines out of the hands of the station operators and place it under the jurisdiction of the linemen who have to make the repairs. Linemen are required to go and see that the main switch is open before they go out on a case of trouble. They must sign a card or tag and attach it to the switch handle. No one else is then allowed to touch the switch without the permission of the man whose name appears on the card. Striking size, color or type makes these cards conspicuous, and such statements as the following are printed on them: "This switch was set by ——— and must not be opened by any other person." "Keep open until notified by ———."


915
DANGER
Don't work on live wires of any voltage.
IT IS PROHIBITED
Use a safety belt when on poles.
IT IS REQUIRED
Use this tag when you open a switch to work on a line.
OBEY THE RULES
THIS SWITCH WAS SET BY
AND MUST NOT BE CHANGED BY ANY OTHER PERSON
THE CLEVELAND-CLIFFS IRON CO.

SAFETY CARDS USED IN MINES

The Cleveland Cliffs Iron Company, Ishpeming, Mich., which has more than 80 miles (130 km.) of 30,000-volt transmission line, adheres rigidly to this practice. The Calumet & Hecla Mining Company, Calumet, Mich., goes one step further and insists that its linemen short-circuit and ground a defective line near the power house. This is done by wrapping a chain around the line in addition to the other precautions mentioned.

S. N. CLARK.

Chicago, Ill.

Grounding Handle of Air-Break Switch to Prevent Accidents

To protect operators from danger attending the operation of the iron handle on air-break switches and to assure the operator that adequate precautions are taken one company has a ground wire attached directly to each handle so that it is in plain view. In addition to this an insulated platform is provided, since there have been cases where an operator received shocks even with frames and mechanism grounded. This was caused, however, by an unusual gust of wind blowing the arc from the horns onto the frame work. To eliminate this danger some of the latest types of switches have horns of such shape that the arc is broken high enough up on them to prevent its being blown to the frame.

Chicago, Ill. T. N. THOMAS.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Mirror for Inspecting Inside of Indirect Lighting Fixtures

DUST on the interior parts of lighting fixtures may be easily seen from the floor by using the device shown in the accompanying illustration. The outfit consists of a convex mirror, such as is used on an automobile windshield, arranged to be held above the fixture by means of a collapsible tube about 5 ft. (1.5-m.) long. This tube may be made from the leg of a camera tripod. Experience with this device has proved its worth in a maintenance campaign which was conducted to show industrial plants the amount of dirt that collects on fixtures and the necessity for systematically cleaning and inspection.

MIRROR USED TO INSPECT CONDITION OF LIGHTING FIXTURES

J. C. STAIR.

Chicago, Ill.

Automatic Control Speeds Up Printing-Shop Production

AUTOMATIC control apparatus installed in a printing plant in Great Britain has increased its output through eliminating starter trouble caused by "inching" and malpractice. Formerly an ordinary starting switch was employed and trouble was constantly experienced from blowing of fuses and burning of the studs on the switch. The main cause of the trouble was "inching" of the presses, which is a necessity in printing. Attempts were made to force the pressmen to do their inching by hand, but they refused, giving as one reason that they had to wash their hands after turning the flywheel. Another source of trouble was malicious blowing of the fuses by throwing in the line switch with the starter in the running position.

After an investigation a push-button-control panel was put on each machine, and since that time much of the trouble has stopped. The presses can be inched without damage and fuses cannot be intentionally blown.

L. E. WOOD.

Glasgow, Scotland.

Electrical Equipment for Coal Mine Operation

BY THE use of electrical equipment through the Moran (Iowa) mine of the Norwood White Company proper operation has been assured so that maximum production can be obtained. In addition, the apparatus can be protected against misuse and can be regulated properly.

For instance the hoist cage, weighing 4,700 lb. (2,100 kg.), is arranged so that the power is automatically cut off and the oil brake is set by a solenoid in case the operator approaches the dumping point at too high a speed or tries to pull the cage through the dump horns. This cage makes an average of two and one-half trips per minute with a 1,500-lb. (680-kg.) car and 4,000 (1,800 kg.) lb. of coal. A herringbone gear and flexible coupling connect the hoist with the motor.

CONNECTED LOAD OF COAL MINE

Name of Apparatus	Capacity	Hp of Motor	Speed Constant or Variable	Location of Motor
Hoist	5T. coal per min. 330 ft. travel	300	Variable	Hoist house
Ventilating fan, 120 in.	70,000 cu.ft. air per min	35	Variable	Air shaft
Crusher		25	Constant	Tipple
Car hoist		15	Variable	Shaft bottom
Shaker		10	Variable	Tipple
Pump	50 gal. per min., 350 ft. head	10	Constant	Shaft bottom
Shop motors		10-15		Shop
Lighting circuit				

In the shop an aggregate of 10 hp. to 15 hp. of individual 440-volt, 25-cycle motors drive a forge blower, a power hammer, a drill press, saws, etc.

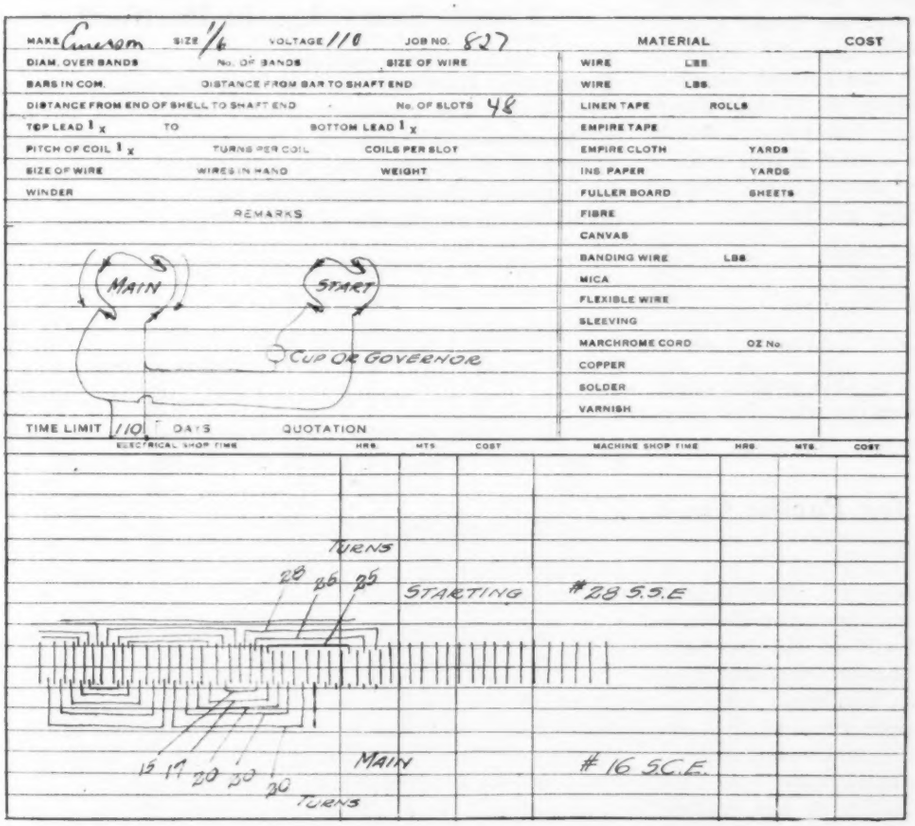
The 22,000-volt line of the Inter Urban Railway Company, Des Moines, which supplies the energy, terminates in a 300-kw. Delta Star substation. The expanded steel tower of this station occupies a ground area of 18 ft. (5.5 m.) by 8.5 ft. (2.6 m.), the height above ground being 25 ft. (7.6 m.) with corner posts set 5 ft. (1.5 m.) in concrete foundations. A guard fence approximately 10 ft. (3 m.) high will completely surround the tower. The three switching and protective units spaced on 6-ft. (1.8 m.) centers consist of a double-break-per-phase switch, a long-turn choke

coil, a carbon-tetrachloride fuse and a high-speed sphere-gap graded resistance lightning arrester. The switch elements are mechanically interlocked and can be opened and closed from ground level by means of a lock-type handle. The 22,000-volt energy is transformed to 440 volts by means of three 100-kw. single-phase transformers. Other transformers step-down the current to 110 volts for the lighting circuits. Construction of this plant was in charge of Mr. Kinnard, chief engineer of the Norwood White Company.

Des Moines, Iowa. K. J. KEITH.

Cost Data Card Record for Electrical Repair Shop

IN THE repair shop of the American Electric Service & Maintenance Company, Springfield, Mass., a convenient card record is maintained in order to determine the cost of motor-winding jobs. The cards, which are illustrated herewith, are 8 5/16 in. long by 7 5/16 in wide



BOTH COST AND WINDING DATA ARE RECORDED ON PRINTED FORM

(21 cm. x 18.5 cm.). They are designed to accommodate all the essential information and dimensions involved in armature, rotor or field winding, with space for all classes of supplies used, cost extensions, labor record in mechanical and electrical shops. On complex work the cards bear diagrams of winding connections. It is customary to show the relation between slots and coils in developed form, as illustrated, with the number of turns of wire of specified insulation concerned in the inter-slot connections. Thus, on the card shown, the typical starting winding and the main or running coils of a ⅛-hp., 110-volt Emerson motor are illustrated.

Springfield, Mass. H. S. KNOWLES.

Method of Installing Armored Cables in Mines

IN THE installation of heavy armored cables in its shafts the Copper Range Company, Michigan, uses the hoisting engines to do the work of lowering. In the case of a 3,000-ft. (914.6-m.) feeder of three sections the top section was installed first. (All shafts on the properties of this company are inclined shafts, 70 deg. with the horizontal).

The reel was set up at a distance of 500 ft. (152.4 m.) from the shaft house, and the end of the cable was dragged to the shaft by the use of a team and started down the ladder compartment where it was to be installed. When about half of the cable had been fed out and its weight was beginning to overbalance the part that was dragging on the surface, logs were chained to it to give the necessary braking effect and others added as required. The team was used to pull the cable toward the shaft. As the end was approached the entire weight of the cable was sustained by the braking action of the logs. A 1¼-in. (3.2-cm.) block and tackle was used on the cable as a safety feature at the shaft house, hitches being made every 25 ft. (7.5 m.) as the cable advanced. Ropes tied to the end were used to guide it as it passed down the ladder compartment.

The second section was handled in the same way, but was fed down the shaft instead of the compartment in which it was to be finally installed. When 1,000 ft. (304.8 m.) were hanging in the shaft the end was looped through the eye of the hoisting rope and clamped there. The entire 1,000 ft. (304.8 m.) was then slowly lowered by the hoisting engine until the lower ends of the section came to the point where the first section ended. The second section was then started down the ladder compartment into place. The operation was repeated with the third section, except that it was necessary to lower 2,000 ft. (610 m.) before it was swung over and started down the ladder compartment.

As soon as a run was in place it was stapled to the mine timbers with a 2½-in. x 5-in. (6.3-cm. x 12.7-cm.) staple made from ½-in. (12.9-mm.) iron rod by starting from the top and working down.

The method of lowering a section to the place where it is to be worked in does away with having to convey the reels underground. The length of each section is determined entirely by what it is considered feasible to handle.

JOHN E. ROCK,
Foreman, Electrical Department.

Painesdale, Mich.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Cost of Heating a Five-Room Apartment by Electricity

THE Nason Apartments at Tacoma, Wash., have been successfully heated by electricity. This is an ordinary frame apartment house, three stories high, containing six apartments of four and five rooms each. There is no furnace in the building, but in each apartment there is a Humphrey "radiant gas wire" for emergency use. As yet these have not been used. Cooking and water heating are done by gas.

In each apartment two Hotpoint Electric Heating Company's 220-volt, 18.6-amp., five-heat Model E electric heaters are used, plugged into special circuits by means of baseboard plugs. In the coldest weather these heaters keep the apartments at 70 deg. Fahr. or more. The Municipal Electric Company makes a special rate for heating, which is half a cent a kilowatt-hour. The following figures show actual bills during a season for heating a five-room apartment:

September-November	$4.35	March-April	$5.20
November-December	3.75	April-May	3.40
December-January	6.95	May-June	1.70
January-February	8.40		
February-March	6.65	Total	$40.40

The simplicity and efficiency of this system show what can be done with electric heating when low rates are obtainable.

Electrical Press Service for Pacific Coast Newspapers

WITH a record of 10,000 pages of advertising in a year in California alone, under the stimulus of the campaign being carried out by the publicity committee of the Pacific Coast Section, National Electric Light Association and the California electrical co-operative campaign, it has been realized that the newspaper interest thus aroused should be maintained. The recent introduction of electrical pages into most of the leading newspapers of California has brought with it a corresponding willingness on the part of the press to feature electrical news items. Some of the papers have given word of a definite correspondence between the pages of advertising and the number of column inches of electrical publicity they are willing to give in their reading pages, and all are more cordially receptive to that type of news.

It is not always convenient for the electrical man to furnish the desirable news items from his personal store of information. The local representative of the power company or the contractor-dealers of a small community may not have a wealth of such material on hand. Recognizing the difficulties of local problems as well as the importance of seeing to it that the right type of news alone represents the electrical industry to the public, the publicity committee of the Pacific Coast Section, N. E. L. A., has instituted a regular press service which is furnished to electrical men and to such newspapers as may request it for their own use. This is issued in the form of a newspaper sheet containing news items, a record of important meetings and brief articles of interest taken from the electrical magazines. It is planned to extend the scope of the paper later on, as well as its mailing list.

Central-Station Business Today and Twenty Years Ago in Hartford

IN A SMALL folder entitled "Twenty Years of Progress" the Hartford Electric Light Company, Hartford, Conn., has presented a very interesting review of the company's expansion. It is pointed out that the growth of its business and a reduction of its rates are the result of the continually increasing demand of the public for more electric service. This information is

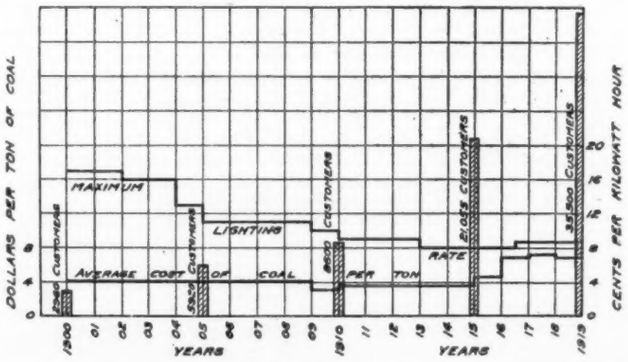


FIG. 1—RELATION BETWEEN RATES AND NUMBER OF CUSTOMERS, TAKING INTO ACCOUNT COST OF COAL

shown in the two curves which are reproduced, one showing the relation between rates and number of customers and the other showing reductions in amount of coal used due to more efficient plant equipment.

From the table which is also reproduced some interesting data are given by way of comparison between the operating conditions of 1900 and 1919. For

DATA ON GROWTH OF HARTFORD ELECTRIC LIGHT COMPANY

	Dec. 31 1900	Dec. 31 1919
Generating Plant:		
Pounds coal used per kw.-hr.	7.7	2.01
Tons coal burned yearly	4,285	73,000
Kilowatts capacity in generators	3,550	37,500
Distribution System:		
Miles of overhead wire installed	533	2,036
Miles of underground duct installed	13.5	450
Number of poles installed	4,200	16,942
Kilowatts of transformers installed	3,000	48,500
General:		
Number of customers served	1,960	35,500
Investment per customer	$524.62	$231.60
Number of employees	65	510
Number of meters installed	1,035	32,778
Number of incandescent lamps installed	80,000	698,817

instance, the coal required to generate a kilowatt-hour of electrical energy in 1900 was 7.7 lb., while in the year 1919, under more favorable and efficient operating conditions, the amount was reduced to 2.01 lb. It is also interesting to note that the investment per cus-

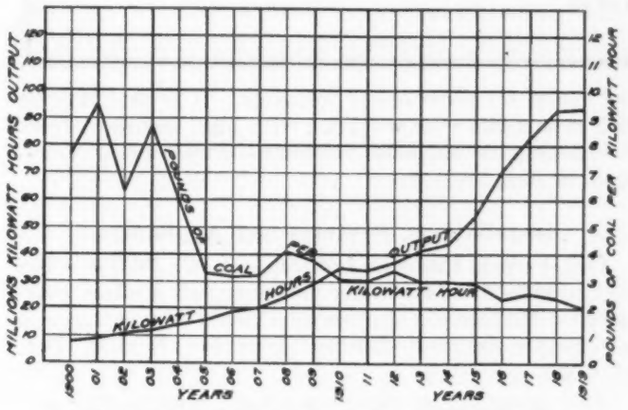


FIG. 2—REDUCTIONS IN AMOUNT OF COAL USED DUE TO INCREASED OUTPUT AND MORE EFFICIENT EQUIPMENT

tomer in 1900 was $524.62, while in 1919 it had been reduced to $231.60. Again, while sixty-five employees were required to operate 3,550 kw. capacity in generators and maintain 546.5 miles of distribution system in 1900, twenty years later 510 employees were able to take care of 37,500 kw. of station generators, or more than ten times the capacity in 1900, and 2,486 miles of distribution system, or five times that of 1900.

How Load Center of Mines Changes

THE Empire District Electric Company of Joplin, Mo., finds that the revenue obtained from its zinc mine loads varies considerably with the market price of zinc ore and the location of the load shifts also. Up to about four years ago the center of the zinc mine load was at Webb City, about 10 miles northeast of Joplin, whereas now the bulk of this load centers around Picher, Okla., which is about 20 miles southwest of Joplin.

Picher, Okla., was an entirely new field, and on Jan. 1, 1915, required only 430 hp. from the central-station lines. However, the load grew rapidly, and in succeeding years it amounted to 3,890 hp., 9,930 hp., 19,555 hp. and 27,582 hp. respectively. The maximum demand of the Picher district is now about 16,000 kw. This includes substations, aggregating 8,500 kw. in capacity, which were moved from Webb City to Picher.

Favorable Publicity for a Southern Public Utility

THE accompanying illustration is part of a full pictorial page which recently appeared in the illustrated section of a Sunday newspaper printed at Charlotte, N. C. The spirit of the message it carries indicates a relationship with local newspapers that is a mighty power in building up public relations.

The Southern Public Utilities Company owns the electric light, gas and street railway properties in Charlotte, N. C., and Greenville, S. C.; the electric light and street railway properties in Winston-Salem, N. C.; similar properties in Anderson, S. C., and the electric light properties in Thomasville, Belmont, Mount Holly, China Grove, Bessemer City, Hickory, Raw Creek, Hoskins and Reidsville, N. C., and Chester, Greer and Fort Lawn, S. C. It operates hydro-electric stations near Anderson, S. C., on the Seneca River, at Portman Shoals on the Savannah River, near Anderson at Gregg Shoals, and on the Yadkin River near Winston-Salem. It also operates steam plants at Anderson, S. C., and Winston-Salem and purchases energy at wholesale from the Southern Power Company.

HOW A CHARLOTTE (N. C.) NEWSPAPER IS INTERPRETING THE MEANING OF CENTRAL-STATION SERVICE

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Alternators Rated at 22,000 Kva. for Glomfjord.—J. WENNERBERG.—Two large three-phase generators, built for the Norwegian government's plant at Glomfjord, were recently completed by the Asea works in Vasteras, Sweden. The alternators are rated at 20,000 kva., with a continuous overload capacity of 22,000 kva., and thus are the largest water-turbine-driven generators ever built in Europe. The article exhibits tracings and photographs of these generators, and takes up some details of design. The speed is 300 r.p.m., and the alternators give 15,000 volts at 25 cycles. The rotor is made of several pieces of cast steel and weighs 95 tons. The stator, which weighs 130 tons, is built in four parts, to facilitate transport. When in place it may be rotated one-half turn, to give access, in case of repairs, to the coils in the lower part.—*Teknisk Tidskrift, Elektroteknik*, November, 1919.

Generation, Transmission and Distribution

The New England Power Company.—E. A. DILLARD and H. R. WILSON.—The authors discuss the development of this system, which is a combination of several smaller systems. Operating problems are discussed in

Failure Customer's Apparatus - 30%
Failure Substation Apparatus - 5%
Lightning - 26%
Miscellaneous - 12%
Unknown - 11%
Sleet and High Winds - 7%
Careless Operation by Customers 5%
Careless Operation by Company

DIAGRAM SHOWING DISTURBANCES ON TRANSMISSION LINE

detail, and a year's record of disturbances on the line is shown in the illustration.—*General Electric Review*, November, 1919.

Industrial Power.—In discussing this subject at the Worcester Section of the American Society of Mechanical Engineers held Dec. 16, 1919, Reginald J. S. Pigott called attention to the considerable advantages of central-station supply compared to those derived from isolated plants. The principal factors to be considered, he said, were the size of the plant, its economy load factor, the cost of fuel, reliability, the space occupied and the cost of the installation per kilowatt installed.—*Power*, Jan. 20, 1920.

Estimating Manhole Costs.—E. E. GEORGE.—In this article equations are derived for use in estimating manhole costs for purposes of valuation. It is said that by this means two men can price with high accuracy, from field notes, 100 manholes per hour.—*Engineering News-Record*, Jan. 20, 1920.

Installations, Systems and Appliances

Coil Versus Magneto Ignition.—A. C. BOOTH.—The writer gives his reason for favoring coil ignition compared with magneto ignition as a result of experience in automobile service.—London *Electrical Review*, Dec. 12, 1920.

Arc Welding.—F. A. ANDERSON.—The writer discusses the effect on the metal of its passage through the arc, the composition of electrodes and other relations between electrodes and current metal.—*Journal of Electricity*, Dec. 15, 1919.

Electric Current Rectifiers.—A brief discussion of the five following types of rectifiers: (1) mercury arc, (2) electrolytic, (3) vibrating tongue or relay, (4) thermionic, (5) mechanical, with rotating parts and commutator.—*Post Office Electrical Engineers' Journal*, October, 1919.

Electrical Cleaning of Gases as Applied to Blast Furnaces.—N. H. GELLERT and K. V. LAIRD.—The article describes the installation of a new type of blast-furnace gas cleaner and the results obtained with it at the furnace of the American Manganese Manufacturing Company of Dunbar, Pa. The cleaner is an adaptation of the Cottrell electrical precipitation process to the blast furnace. This process, while new to the blast furnace, has been in extensive use throughout the country in the cement industry as well as in various metallurgical processes. The cleaning of blast-furnace gases is of importance in obtaining plant efficiency and the lowering of the available heat in the gases. The operation of iron and ferro-alloy furnaces at maximum possible efficiency is now imperative owing to keen domestic competition as well as a constantly rising foreign competition.—*Journal Engineers' Club of Philadelphia*, December, 1919.

The Almissa Power Station in Dalmatia.—H. TANZER.—A 100,000-hp. hydro-electric power station, constructed to utilize the water power of the Cetina River, has recently been put in operation, and in this article a detailed description of it is given. High-pressure 1,800-hp. turbines are installed. The generators are rated at 1,600 kva. and at 4,000 volts, each one being provided with a step-up transformer for a transmission voltage of 56 kv. A considerable proportion of the power is used in electrochemical plants.—*Elektrotechnik und Maschinenbau*, April 27, May 4 and 11, 1919.

Electric-Resistance Furnace of Large Capacity for Zinc Ores.—CHARLES H. FULTON.—The paper includes a description of the furnace and process of using briquettes of zinc ore as resistors for the electric furnace. *Chemical and Metallurgical Engineering*, Jan. 14, 1920.

Electrophysics and Magnetism

Treatment of Harmonics in Alternating-Current Theory by Means of a Harmonic Algebra.—A. PRESS.—The writer states that this monograph will be found to introduce a new mathematical operator, Q_m, which enables one to solve with comparative ease problems in alternating-current circuits which have heretofore been regarded as impossible of solution.—*University of California Publications in Engineering*, Sept. 30, 1919.

Units, Measurements and Instruments

Improved Meter Design.—J. SCHMIDT.—In kilowatt-hour meters of the direct-current-motor type the increasing friction on the commutator, due to wear under the brushes, is usually a serious cause of disturbance. In a design by the Allgemeine Elektrizitäts-Gesellschaft the wear is much diminished by putting the brushes on a lever actuated by an electromagnet in series with the load. The position of the brushes then will vary with the load, and heavy wear due to severe sparking at an occasional overload will therefore not effect the readings of the meter under ordinary load conditions. Friction is also cut down by running both bearings in oil. The upper bearing is inverted, a small fixed shaft projecting down into an oil chamber on top of the motor shaft, while the lower one is a special ball bearing consisting of one highly polished steel ball running on a sapphire. In the later part of this article arrangements are described whereby the meter may be adapted for use in cases where double-rate systems are used. If a special rate prevails during certain hours, the motor gear is automatically meshed with one or the other of two indicating clockworks by means of an electrically driven clock. Where a power limit is prescribed the meter is provided with a differential mechanism so that it goes in operation only when the load exceeds a certain wattage and measures only the surplus consumption.—*Helios*, Aug. 24 and 31, 1919.

Standard Vacuum-Tube Notations in German Literature.—During the war a number of notations for vacuum-tube quantities have come into being and seem to be accepted by most German writers on the subject. To facilitate the reading of a number of articles dealing with recent progress in the theory of electron-discharge tubes whose publication has been delayed by the military censor, but which are now appearing in various magazines, Barkhausen has compiled some of the most satisfactory notations, and, in co-operation with the editors of the *Jahrbuch der Drahtlosen Telegraphie* and the *Archiv für Elektrotechnik*, suggests that these be uniformly accepted as standards. To distinguish between the various circuits indexes are used: a for the plate circuit, g for the grid-circuit, and h for the filament-circuit. $I_g = f(E_g)$ and $I_a = f(E_a)$ are denoted as the grid-current and anode-current curves, while the plate current-grid voltage curve is called the characteristic. The interior resistance is defined as $R_i = \partial E_a / \partial I_a$, but the voltage amplification factor, μ, as usually defined in this country, does not appear. Instead is introduced its reciprocal, $\partial E_g / \partial E_a$ (for constant plate current), which is called D and is a fraction, indicating what percentage of the plate's field acts on the filament through the screening effect of the grid. The mutual conductance $\partial I_a / \partial E_g$ is indicated by S.—*Jahrbuch der drahtlosen Telegraphie*, May, 1919, and *Archiv für Elextrotechnik*, July 15, 1919.

Measurements on Vacuum Tubes.—H. G. MOELLER.—Three-electrode vacuum-tube characteristics may be determined either directly, or by calculation from the direct-current characteristic curves. A number of laboratory methods are outlined in this paper, for the experimental determination, by both these schemes of various amplifying and oscillating properties. A difficulty in obtaining comparative results arises from the indefiniteness due to current inequality at the two ends of the filament. The author therefore suggests that in testing tubes the plate current be adjusted to a prescribed value rather than the filament current. An emission current of 4 milliamperes per watt heating power is said to be usual for small non-coated-filament tubes.—*Archiv für Elektrotechnik*, July 15, 1919.

Telegraphy, Telephony and Signals

German Aircraft Radio-Telegraphy.—E. NIEMANN.—During the war much energy was devoted in Germany to the problem of getting a reliable radio communication with airships of all kinds, and as a result a number of aircraft radio stations were developed and standardized. The various types may be divided into three groups—outfits for ordinary patrol planes and battle planes, for the bigger bombing planes, and for the giant fliers of later years. The article gives a description of a number of airplane stations for various purposes and deals in detail with many practical questions, such as radiation characteristics of airplane and airship antennas, construction of air-screw-driven dynamos, effect of lowered air pressure upon quenched-spark transmitter output, etc.—*Jahrbuch der drahtlosen Telegraphie*, May and July, 1919.

Comparison Between Coil Antenna and Open Antenna for Receiving.—MAX ABRAHAM.—The energy absorption of a coil placed in an electromagnetic radiation field is theoretically investigated, and it is shown that the Rüdenberg theorem holds also for a coil antenna. The maximum detector energy is obtained when the detector resistance is equal to the antenna resistance and is to its value independent of the antenna constants. Inasmuch as the radiation resistance of a coil is very small, optimal conditions are here difficult to realize. The coil antenna, however, is analytically shown to be less susceptible to static disturbances than the open antenna.—*Jahrbuch der drahtlosen Telegraphie*, August 1919.

Recording of Eifel Tower Time Signals for Determination of Clock Error.—L. B. TURNER.—The experiments described in this paper were instigated by a demand for wireless recording apparatus to be used in determinations of longitude for survey work in East Africa. The precise determination of clock error, however, is of importance everywhere. The time signals discussed, besides being timed more precisely than is possible with the ordinary time signal, allow the skilled observer to compare his chronometer with the Eiffel Tower to within a tenth of a second without resort to any apparatus beyond a simple auditive wireless receiver.—London *Electrician*, Nov. 14, 1919.

Some Comparisons of Automatic Exchange Systems.—In this article may be found a comparison of three different systems of automatic telephony which have found considerable use in Great Britain. They are the Siemens, the Western and the Automatic Telephone Company Systems.—*Post Office Electrical Engineers' Journal* (London), January, 1920.

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

ARMATURE, DIRECT-CURRENT, FLUX DISTRIBUTION IN AIR.

The purpose of this investigation is to determine the theoretical distribution of magnetic flux and potential around a stationary multi-polar direct-current armature removed from the field structure and entirely surrounded by air. The current is conducted into the armature in the usual way through the brushes so that electromagnetically the armature is equivalent to an excitation by belts of current of alternate polarity. The impetus to this investigation was given by a serious discrepancy between some experimental results which under the above conditions give a "peaked" flux distribution and a "flat" distribution as derived theoretically by E. Arnold under much simplified assumptions in his "Gleichstrommaschine," 1906, Vol. I, pp. 378 and 384. The new theory checks quite closely with the experimental data given in the *Electrician*, Vol. 75 (1915), p. 960. The magnetic field is mapped out by means of conjugate functions.—*James McMahon, Cornell University, Ithaca, N. Y.*

CORONA VOLTMETER.

There has recently been completed a series of precision measureemnts of the crest value of alternating voltages, taken in the high-voltage circuit, using a large air condenser and both kenotrons and commutators for measuring its charging current. This work has been done in connection with an accurate determination of the constants of the corona voltmeter. With these constants the instrument will become a standard of high voltage; that is to say, its calibration or range is inherent in its dimensions. The law of this instrument has been extended over a much wider range than heretofore, and certain new facts have appeared. A paper describing the work is in course of preparation.—*J. B. Whitehead, Johns Hopkins University, Baltimore, Md.*

CORROSION IN CABLES.

A peculiar case of corrosion of lead cable sheaths used by a St. Louis power company was investigated, in which it was found that the difficulty was probably due to a combination of several causes, chief of which was the subjection of the cable system during its first few months' use to very high positive potentials. Subsequently failures gradually developed, due particularly to the elevated temperature at which the cables were operated and to the peculiar type of conduit used.—*Bureau of Standards, Washington, D. C.*

ILLUMINATION IN FACTORIES, EFFECT OF PAINT UPON.

Illumination tests are being made in factories, before and after painting, with a view to discovering the increase in light afforded by the paint. Brightness comparisons (before and after) are also being made with the intention of determining the relative distinctness of dark machinery and light-colored walls and the contrast between the same and the source of light. An attempt is also being made to estimate the effect of surrounding structural surfaces on vertical illumination.—*H. Logan, New York City.*

RADIO DIRECTION FINDER.

A simple coil of wire has been found to form a good receiving device for radio waves, and does away with the necessity of an antenna for a great deal of radio work. The receiving circuit used with such a device is the simplest possible radio circuit, namely, the coil with a condenser in series, with a detecting device connected across the condenser. The great advantage of this method of radio reception is that the direction of propagation of the radio wave is determined by rotating the coil. The received signal disappears when the plane of the coil is perpendicular to the direction of the advancing wave. By rotating the coil the direction can be determined to about one degree. This has been found very advantageous in preventing interference. Thus the coil can be turned in such a direction that waves from a certain source are entirely eliminated while the signal from a different direction is received. The device has also been applied to determining the actual position of a transmitting station by a simple process of triangulation. This has been utilized in finding the positions of ships and airplanes as well as stations on the ground, and it has been of the greatest use in trench warfare. Special apparatus of this sort has been developed for use on ships for determining the position and steering toward a lighthouse during fog. Progress has been made toward the determination not only of the line of direction but also of the absolute direction of propagation of a wave.—*Radio Laboratory, U. S. Bureau of Standards.*

Suggestions for Research

ALLOY, SPECIAL.

An alloy or a metal is required having a very large temperature coefficient of expansion, preferably equal to or greater than that of aluminum; the material must possess a high resistivity, preferably greater than that of German silver and similar alloys, and it must also have a relatively high melting point, preferably greater than that of copper.—*Chester I. Hall, Fort Wayne, Ind.*

CONDUCTORS, IRON, AS SURGE PROTECTORS.

Theoretical investigations by H. M. Pleijel, Stockholm, show that transient traveling waves on a transmission line of iron wire are very rapidly damped down, especially at the wave front. This seems to indicate that a mile or so of iron conductor just outside the transformers may be the best and cheapest surge-protecting device to be had, since the dangerous energy is absorbed as skin-effect losses on the line, where no appreciable heating can occur. Apparently there are no experimental data available in the literature, and it would be of great interest to make quantitative tests of an actual line, preferably where high tension is available. A choke coil could be inserted at a point in the line and the maximum drop across the coil measured with sphere gaps, a rectangular high-voltage wave being started by switching on high tension at the home end. A variable length of iron conductor could be inserted just before the choke coil, while suitable means would be provided to avoid reflections and accidental superpositions.—*Edy Velander, Harvard University.*

[This is an expedient which has been brought up many times. It should receive the attention of those in a position to make tests under practical transmission line conditions.—EDITOR.]

FUSES FOR MEASURING INSTRUMENTS.

A great many movements of electric measuring instruments, especially of the moving-coil type, are burned out each year by accidental overloads. No one seems to have succeeded in developing a simple, reliable and inexpensive fuse, or other protective device, to prevent these burn-outs. Especially in college laboratories, the loss in instruments is quite heavy, and a suitable fuse would be extremely valuable.—*Editorial Suggestion.*

INSULATING MATERIALS FOR USE IN RADIO APPARATUS.

There is need for research covering the following items: (1) Measurement of dielectric constant and phase difference of bakelite and similar phenol materials—porcelain, woods and other dielectrics used in radio apparatus; (2) measurement of properties of liquids used in radio apparatus; (3) effects of moisture and variation of laboratory conditions upon properties of insulating materials; (4) measurement of effects of high voltage on various classes of insulating materials to determine their serviceability in radio generating outfits.—*J. H. Dellinger, U. S. Bureau of Standards.*

INSULATION, OPERATING CONDITIONS OF.

The particular conditions under which electrical apparatus has to work and which require special consideration, as far as insulation is concerned, are as follows: (1) Ordinary service conditions, where neither extremes of heat, dampness or dirt and grit are encountered; (2) where extremes of dirt and grit are encountered; (3) where extreme conditions of heat or room temperatures are encountered; (4) extreme humidity with heat and with or without salty atmosphere; (5) atmosphere with alkali fumes; (6) atmosphere with acid fumes. The insulation for withstanding these conditions should not only be investigated with the view to making apparatus which will stand up for a number of years without a break-down, but should also be studied with the view to preventing leakage or lowering the insulation resistance.—*J. L. Hamilton, St. Louis, Mo.*

INSULATORS, LIFE TEST FOR.

In actual service insulators are subjected to mechanical forces from the following causes: (1) Electrostatic field; (2) weight of conductor, including wind and sleet; (3) temperature differences in the material; (4) volumetric changes in the cement. These forces have in the past shortened the economic life to but a few years. Improvements tending to counterbalance the effect of these forces are continually being made, but their efficacy cannot be absolutely determined for a number of years. In order to estimate the value of such expedients it is desirable to devise comprehensive tests not merely electrical, which will take all the factors into account, and will give at the outset a reliable indication of expected life.—*Editorial Suggestion.*

INSULATORS, PIEZO-ELECTRIC EFFECT IN.

Porcelain is a conglomerate with crystals of quartz and sillimanite ($Al_2O_3SiO_2$) embedded in feldspar glass. It is known that when some crystals are subjected to an electrostatic field mechanical stresses are developed therein. It has been suggested that such stresses might occur in the materials of which porcelain is composed, and it would be of great practical importance to determine whether or not they are of sufficient magnitude to cause physical deterioration which leads to cracking.—*W. A. Hillebrand, Ohio Brass Company.*

TELEPHONE, AUTOMATIC, RELAYS.

A further study and development of automatic relays is recommended, both of the quick-acting and the slow-acting type—their structure and performance. The investigator should first acquaint himself with the normal function of these relays in automatic telephony and then make a mechanical and experimental investigation of their performance and the effect of structure and adjustment upon that performance.—*A. B. Smith, Chicago, Ill.*

WELDING, ELECTRIC.

It is desired to devise a practical and scientific method of testing a welded joint after it has been made. There have been a number of suggestions made for the solution of this problem. They are briefly as follows: (a) Mechanical—by hammering the weld or by chipping at frequent intervals; (b) by means of resistance or voltage drop; (c) magnetic—by means of the permeameter or the change of conditions in the magnetic circuit; (d) X-rays—by means of an exposure on an X-ray plate. At the present time none of these suggested methods have been productive of conclusive results and recourse must be had to crude mechanical methods, such as striking heavy blows on, or adjacent to, the weld, by using a chipping hammer and making intermittent examinations.—*H. A. Horner, A. I. E. E. Proceedings*, 1918, *page* 1192.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Atlantic Seaboard Super-Power System Hearings

HEARINGS on the Boston-Washington super-power system were held this week before the House committee on appropriations. W. S. Murray and Profs. Breckenridge and Jackson appeared before the committee and testified in great detail. Owing to a regulation of the appropriations committee to the effect that testimony before it cannot be released for publication until the entire hearing is released it is not possible to report the testimony this week.

General Electric Leases War Plant of Remington Company

ANNOUNCEMENT has just been made that the General Electric Company has leased, with option to purchase, the forty-acre war plant of the Remington Arms Company at Bridgeport, Conn. This transaction provides the company with 1,500,000 square feet of floor space, available almost immediately, for the production of light rather than heavy apparatus. The plant consists of thirteen identical unit buildings easily accessible and conveniently interconnected. The General Electric Company is not now prepared to state exactly what material will be manufactured there, but it is the company's belief that this new space will be given over to light and smaller apparatus which can easily be adapted to quantity production. According to the present condition of business, the company could utilize this space for virtually any kind of apparatus, the need for space is so great. It is expected that between four and five thousand employees will be required to man the plant.

Kansas Plan of Utility Control Finds Legislative Advocates in East

STATE SENATOR WHITE of New Jersey has introduced a bill into the Legislature that would replace the State Board of Public Utility Commissioners by a Court of Industrial Relations similar to that just installed in Kansas, as recorded in the ELECTRICAL WORLD of March 13. The proposed New Jersey court would handle all utility, transportation and industrial matters and would be made up of three judges to be named by the Governor, with approval of the Senate, the members to serve three years at an annual salary of $5,000 and to give their full time to the work.

A bill has been introduced into the New York State Assembly for the creation of a Court of Industrial Relations to consist of three judges appointed by the Governor, with consent of the Senate, at $10,000 per year, for the purpose of preventing strikes and to exercise other functions of the same nature. The operations of clothing manufacture, mining or production of material in common use as fuel, manufacture and handling of iron and wood products, wearing apparel, fuel or food products, all public utilities and all common carriers are declared subject to state supervision.

Drought Threatens Power Shortage in Idaho and Oregon

JUST as California, aided by recent rains, is apparently surmounting the handicap caused by the long drought, Idaho and Oregon find themselves facing a serious water shortage from the same cause. In the former state, where the electric power companies have a large business from the irrigation districts, an effort will be made to overcome the shortage by shifting the load.

The water conservation board formed in California, as announced in the ELECTRICAL WORLD last week, to reduce the loss from the drought and determine priority of water claims has been made permanent. The San Joaquin Light & Power Corporation has announced to the oil producers that there will be no further curtailment of power.

Some "High Lights" on the Pasadena N. E. L. A. Convention

FINAL details of the program of the forty-third convention of the National Electric Light Association, to be held at Pasadena, Cal., May 18-21, are fast rounding into shape and are expected to be ready for announcement next week. A four-day program replete with interest for all affiliated with the electrical industry has been prepared in such a manner that virtually every phase of development during the past year has been covered. Prospective development during the coming year also is dealt with.

Guests and members of the association who are particularly interested only in the four general sessions and in one or two of the eight sectional sessions will have an unusual opportunity to enjoy scenic trips, golf, tennis, bathing, boating, dancing, etc.

The address of welcome will be delivered by Governor William D. Stephens of California at the opening session of the convention, on the morning following the reception given by President R. H. Ballard.

President Ballard will respond to the Governor's address on behalf of the association and will deliver the president's address. He will be followed by M. H. Aylesworth, executive manager of the association, who will outline the reorganization of the body to date, telling what has already been accomplished and the complete plans for the coming year.

Following these addresses will come the presentation of reports and technical papers and their discussion. General sessions will be held in the mornings, and special sectional sessions in several instances necessar-

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

BECAUSE of the sustained heavy demands and the bad transportation conditions, the worst shortage of electrical supplies on record is reported, not even making exception of those that obtained in the height of the war. Prices, however, appear to be steady. Porcelain insulators, cross-arms, locust pins and line hardware are reported up. Copper is still going down, and the metal market is dull.

CARLOAD shipments from the West were received by Boston jobbers at the close of last week, after a tie-up of nearly a month resulting from adverse weather.

THE COAL crisis appears to have passed its worst stage, as New England central stations see the situation. Recent thaws have begun to increase the hydro-electric power yield, which on one large system ran down to a minimum of 10 per cent of the plant rating during the period of coldest weather.

ABOUT 200 contracts for industrial co-operation and research have been placed with the Massachusetts Institute of Technology to date.

THE ANNUAL convention of the New England Section, N. E. L. A., will be held at Kineo, Me., from Sept. 14 to Sept. 16.

EXTENSIVE improvements, to cost not less than $5,000,000, are being planned by various electric companies in Arizona.

ABOLITION of the national service committee of the Engineering Council, with retention of a "national service representative" at Washington, is advocated in the annual report of the committee named, which covers the year's accomplishments in furthering public movements of especial interest to engineers.

MEASURES to establish state bodies similar to the Court of Industrial Relations which has superseded the Public Utilities Commission in Kansas have been introduced into the legislatures of New Jersey and New York.

AN ALL-DAY question box conference was held by the New England Section of the N. E. L. A. at Boston, Mass., on March 18. Members of the Massachusetts State Branch of the National Association of Electrical Contractors and Dealers postponed their regular monthly meeting in order to attend.

A CONSOLIDATION of the Habirshaw Electric Cable Company, Inc., the Electric Cable Company and the Bare Wire Company, Inc., has taken place, the resulting corporation being known as the Habirshaw Electric Cable Company.

ELECTRIC power is to be tried for deep-well drilling in the Oklahoma oil fields in the near future.

REPRESENTATIVES of American industry and of higher education are to be brought together by the Technology Clubs Associated for the purpose of improving the quantity and quality of trained men for management duty.

PLANS for the local marketing of public utility securities in territories served by companies under Stone & Webster management are being matured.

LITTLE evidence of a popular demand for state ownership of electric utilities was manifested at a legislative hearing upon bills with that object sponsored by the local branch of the American Federation of Labor.

SUBSTANTIAL increases in the salaries of government electrical engineers are included among the recommendations made by a joint Congressional committee which has investigated the whole question of the pay of federal employees.

A PRELIMINARY outline of the program of the N. E. L. A. convention to be held at Pasadena, Cal., May 18-21, has been issued, indicating some of the most important committee reports that are to be presented.

THE ANNUAL meeting of the Arkansas Utilities Association will be held at Hot Springs, Ark., from April 26 to April 28 inclusive.

SPEAKING before the Boston Section, N. E. L. A., Dr. E. P. Rosa deplored the handicap put on the work of the Bureau of Standards by inadequate funds.

DELEGATES to a meeting of the Electric Furnace Association will take part in some of the joint sessions of the A. I. E. E. and the American Electrochemical Society at Boston on April 8-10.

GUY E. TRIPP, in a discussion of the production problem, declared his belief that profit sharing is unsound in principle and that, after the provision of a liberal wage, profits and risks should both fall to capital.

RICHARD H. RICE, manager of the Lynn works of the General Electric Company, declares the works council in that plant an unqualified success.

A. W. BERRESFORD of Milwaukee has been nominated for president of the A. I. E. E. by the board of directors.

WHAT is thought to be a world's record for continuous running of machines of its class was reached by a 45,000-kw. Westinghouse turbo-generator recently shut down at the plant of the Narragansett Electric Lighting Company, Providence, R. I., after steady operation for eighty-four and a half days.

OUTPUT and peak load of the Trumbull Public Service Company of Warren, Ohio, are increasing with such rapidity that the company cannot add equipment fast enough to care for the new business.

PROTECTION of rotary converters against flashing was discussed by the A. I. E. E. at its Pittsburgh meeting last week, and two designs for the electric locomotives of the Chicago, Milwaukee & St. Paul Railway were described.

THE SUPERDREADNOUGHT Maryland, which is the fourth capital ship of the navy to be equipped for electric drive, was launched at Newport News, Va., on March 20.

APPLICATIONS for the appropriation of water to generate 600,000 hp. have been made in this year in Oregon.

HEARINGS on the Boston-Washington super-power scheme were held this week before the House committee on appropriations.

PLANS for the increased-membership drive of the Illuminating Engineering Society are taking shape.

PRESIDENT BALLARD of the N. E. L. A. announces that the electric light division of the Oklahoma Utilities Association has passed a resolution favoring affiliation with the N. E. L. A.

BOSTON engineers will be addressed by Herbert Hoover at the Engineers' Club on March 24 at a dinner to be given in his honor.

ANNOUNCEMENT that the General Electric Company has leased, with option of purchase, the plant of the Remington Arms Company at Bridgeport, Conn., is made.

ily paralleling each other will be held in the afternoons. The public policy committee meeting will be held Thursday evening, May 20.

While the program has been arranged tentatively, it is not sufficiently complete in detail to publish in full at this time. Some of the "high lights" of the program, however, follow:

Franklin T. Griffith of the Portland (Ore.) Railway, Light & Power Company will present the report of the committee on water-power development, of which he is chairman. This subject is one of unusual importance and interest at this time in view of the evident present necessity for increasing the production of electrical energy sufficiently to meet the existing and ever-growing demand. By the time his report is presented the national water-power bill will probably have become a law.

"Inductive Interference," at present an absorbing problem, will be dealt with in a report presented by A. E. Silver of the Electric Bond & Share Company, chairman of the inductive interference committee. A summary of the present conditions and problems and recommendations for helpful association activities are contained in the report.

"Electrification of Steam Railroads" will be discussed in the report of a committee on that subject, presented by the chairman, Frank M. Kerr of the Mountain Power Company. Improved practices and the outlook for the electrification of the steam roads of the country are covered.

In the report and subsequent discussion of the committee on electrical resources of the nation, of which M. S. Sloan of the Brooklyn Edison Company, Inc., is chairman, some startling facts are expected to be brought out. This, of course, is really a "key subject," since the extent of future electrical development depends upon these resources and their development.

The numerous phases of electric vehicle activities will be covered in an address by George B. Foster of the Commonwealth Edison Company of Chicago, chairman of the Electric Vehicle Section of the association.

Concrete facts and figures on the value of proper publicity regarding activities and problems of the electrical industry in particular, and of all public utilities in general, will be given in the report of the association committee on public information, of which John F. Gilchrist of the Commonwealth Edison Company, Chicago, is chairman. Under the auspices of this committee and as the result of direct personal activity on the part of the chairman, state committees on public information have been organized in several states.

The importance of the fullest co-operation between all branches of the industry for the mutual benefit of the public and of the industry is given recognition by including in the program a committee report to be presented by Lee H. Newman of the Pacific Gas & Electric Company, San Francisco.

Novel effects in residence and industrial lighting have been developed during the last year, particularly in the use of color. A demonstration of this development, the equipment used and its application will in a large measure fill the vacancy left by the omission of the customary trade exhibit which was made necessary because of distance from trade and manufacturing centers, difficulty of securing prompt and adequate transportation, supply and demand conditions and lack of suitable space for exhibition purposes.

Profit Sharing Unsound in Principle

STIMULATION of production, under a system permitting capital to take the risks and profits after providing a liberal wage which will furnish to the ambitious worker an opportunity to improve his status in the community and to accumulate property, was advocated by Guy E. Tripp, chairman of the board of the Westinghouse Electric & Manufacturing Company, before a meeting on March 12 of the Merchants' Association of New York, held to discuss the problem of increased production.

Nationalization of industry was held by Mr. Tripp to be utterly wrong and impossible of achievement, and its advocacy, he thought contributed to unrest. The restraining influence of labor unions upon the selfish interests of employers, which let alone would tend to a lower wage than the traffic would bear, was felt to be safe. At the same time, complete unionization of labor would reduce production, reduce the standard of living and practically destroy the opportunities for the ambitious man with ability. The solution of the problem, the speaker stated, lay in the maintenance of a proper equilibrium between the self-interest of capital on the one hand and the self-interest of labor on the other.

"If this can be accomplished at all," Mr. Tripp said, "it will only be done by permitting a healthy play of natural forces. A man should be entirely free to belong to a labor union or not, as he pleases, and in this right he should have the full protection of the law. Likewise an employer should be entirely free to run an open shop or a closed shop, as he pleases, and he should be protected in that right."

The right to organize was not questioned, but Mr. Tripp did deny "the justice and propriety of the use of force and lawlessness and improper use of government" to accomplish the workmen's ends. While the speaker believed that every sound effort to improve the human relationship between employer and employee should be encouraged, he said that he believed profit sharing to be unsound in principle.

While no remedy was suggested, Mr. Tripp proposed that there be a general recognition that the problem of production and prosperity is an economic one, and not a sentimental one, and that unrest will not be overcome so long as a considerable portion of the people believe that it is possible to abolish the wage system in this country. "There is almost nothing," Mr. Tripp concluded, "so impossible as that. My industrial creed is a simple one. It is only this—a fair field for diligence, enterprise and intelligence."

Works Council in General Electric Factory Declared Success

AFTER eighteen months' trial the works council system in the Lynn (Mass.) works of the General Electric Company has proved an unqualified success, it was declared by Richard H. Rice, manager of the works, at Boston, this week. The council has without the aid of trade unionism maintained just relations between the management and the employees, said Mr. Rice, not one case in the period named having been appealed from the committee to the manager. Mr. Rice also announced his belief that a forty-eight-hour week is inadequate world production, which this year are 50 per cent greater than in 1914.

Electric Furnace Men to Participate in Electrochemical Meeting

COINCIDENT with the meeting of the American Institute of Electrical Engineers and the American Electrochemical Society, there will be a meeting of the Electric Furnace Association in Boston from April 8 to April 10. The annual election and business meeting will be held on April 8. On one other day there will be a session on the proper training of electric furnace operators. The association will meet with the other two societies during their discussions on "Electrically Produced Alloys" and "Power for Electrochemical Purposes."

Indications are, it is stated, that there will be a considerable attendance of electric furnace men at these sessions.

To Try Out Electric Power on Deep-Oil-Well Drilling

AN EXPERIMENT with electric power for deep-well drilling is to be tried in the Oklahoma oil fields in the near future. The Marland Oil & Refining Company, Tonka City, Okla., will replace a steam outfit on one of the deep wells with electric power. The fact that these wells are drilled to depths of 3,900 ft. and 4,000 ft. made it seem doubtful whether electric power could stand the strain.

It is claimed that the cost of operation and installation of electric power is about one-third the cost of the steam equipment for steam power. The Tonka field is already wired for alternating current from the refinery power house.

In an effort to determine as far as possible the adaptability of electric power for deep-well drilling the production department has installed 35-hp. motors in three of the deep wells already producing. These wells will be pumped for a period to determine the ability of electric power to carry the big loads. One of these motors has been pumping from 50 barrels to 100 barrels daily from Burt Well No. 5 and has been used successfully for pulling rods and cleaning out.

Stone & Webster to Push Sale of Utility Securities Locally

PLANS for marketing securities in territories served by public utility companies under Stone & Webster management are being matured in Boston, and C. W. Kellogg, formerly manager of the Mississippi Power Company, and for the past year in charge of the Stone & Webster investigation and report on the New York Railways and Interborough Rapid Transit properties, has been placed in charge of the work. Mr. Kellogg will make headquarters at the Boston office of Stone & Webster. To a representative of the ELECTRICAL WORLD he stated that the local sale of securities is being pushed because of the belief of Stone & Webster that the market for utility stocks, bonds and notes has greatly broadened of late and that increased local ownership in companies serving communities is sound policy and worth cultivating, especially in view of its beneficial effect on the understanding of conditions which local companies face. The pioneer work of the Pacific Gas & Electric Company and many other utilities in the field of customer ownership has been noted, and some of the Stone & Webster companies—notably at New London, Conn. (before the sale of the Connecticut Power Company to the Hartford Electric Light Company), Pawtucket, R. I., Brockton, Mass., and Pensacola, Fla.—have sold securities locally to advantage. Newspaper publicity will form the backbone of the sales methods.

More Pay for Government Electrical Engineers

AFTER the most thorough investigation ever made of salary classification in the government service, a joint Congressional committee has submitted to Congress a detailed report recommending substantial increases in pay for nearly every class of government worker. Salaries for technical service were found to be strikingly out of line with those paid in private employment. Senator Jones of New Mexico is the chairman of the committee.

Standardization of compensation for electrical and radio engineering are recommended by the committee as follows: Electrical engineering draftsman and electrical engineering aid, from $1,200 to $1,800 annually; junior electrical engineer, $1,800 to $2,160 annually; assistant electrical engineer, $2,400 to $3,000 annually; associate electrical engineer, $3,240 to $3,840 annually; electrical engineer, $4,140 to $5,040 annually; senior electrical engineer, to be determined by Congress upon recommendation by the Civil Service Commission based upon a full appraisal of the duties and responsibilities of the position and its relation to positions in similar classes; assistant radio engineer, $2,400 to $3,000 annually; associate radio engineer, $3,240 to $3,840 annually radio engineer, $4,140 to $5,040 annually.

Berresford Nominated for President of the A. I. E. E.

A. W. BERRESFORD

AT THE meeting of the board of directors of the American Institute of Electrical Engineers held in Pittsburgh on March 12, the report of the committee of tellers on its canvass of the nomination ballots cast for candidates for the Institute offices falling vacant July 31 next was presented.

As required by the constitution of the Institute, the board then selected by ballot its list of "directors' nominees," with the following result: For president—A. W. Berresford, Milwaukee. For vice-presidents—C. S. Ruffner, New York; E. H. Martindale, Cleveland; Charles Robbins, Pittsburgh; C. E. Magnusson, Seattle; C. S. McDowell, U. S. N.; L. T. Robinson, Schenectady.

For managers—E. B. Craft, New York; Harold B. Smith, Worcester, Mass.; James F. Lincoln, Cleveland.

For treasurer—George A. Hamilton, Elizabeth, N. J.

The ballots will be mailed to the membership prior to April 1.

I. E. S. Membership Drive Plans Shaping Up

PLANS for the increased membership drive of the Illuminating Engineering Society, mentioned in these columns two weeks ago, are going forward. At the council meeting last week it was decided to double the membership at large. During the drive, which is to be handled by a general committee now being made up, it is proposed that initiation fees shall be waived and half-yearly dues to Oct. 1, 1920, accepted. In order to keep the present members interested and active and to provide for reasonable growth, sections and proposed local chapters are to be given every opportunity to govern their own finances and activities, under a proposed "declaration of applied ethics," to be set forth by the council. The drive is to be started when the council has agreed to recommend changes in the constitution providing a sufficient degree of financial autonomy to sections and proposed chapters and will be for the duration of three weeks, one an intensive week.

It is proposed to popularize the drive by calling the intensive week "National Lighting Week," or some similar name. A committee of one hundred or more is to be appointed to take care of arrangements and publicity. The general committee is to consist of nationally known men identified with or interested in illumination and to include the publicity committee of the society. With each state chairman will be associated a staff of vice-chairmen, each representing one of the several interested branches of the industry and interested professions.

Consolidation of Habirshaw Interests

TO OBTAIN required working capital as well as to effect economy in their operations the Habirshaw Electric Cable Company, Inc., the Electric Cable Company and the Bare Wire Company, Inc., have been consolidated to form a new corporation, the Habirshaw Electric Cable Company.

The combined gross sales of the constituent companies have grown from $3,597,786 in 1916 to $7,413,652 in 1919, and orders on hand indicate that the 1920 business will be considerably greater than that for 1919. Primarily it was to finance the expansion of the last two years that consolidation was effected.

The Habirshaw Electric Cable Company, Inc., is the outgrowth of a company started in the early eighties by Dr. William F. Habirshaw and known as the India Rubbia & Gutta Percha Insulating Company. It has specialized largely on power and light cables and wires and submarine cables. The Electric Cable Company is the successor to the Clark Wire Company of Boston, organized at about the same time, and has since specialized on telephone wires. Early in 1916 the Electric Cable Company acquired control of the Habirshaw company, and in the same year the two companies organized the Bare Wire Company, Inc., which built a factory for the manufacture of bare copper wire.

The new company has sold $2,000,000 of 7 per cent sinking-fund convertible gold debenture bonds, due 1935, and 40,000 shares of common stock without par value. There are outstanding in addition 95,000 shares of common stock and $1,340,700 of 8 per cent cumulative preferred stock.

Electric Traction Subjects Discussed at Pittsburgh Meeting of A. I. E. E.

CONSIDERABLE information, including test data, regarding the protection of 60-cycle synchronous converters was brought out at the three hundred and eighty-fifth meeting of the American Institute of Electrical Engineers, held in Pittsburgh on March 12. Papers on the automatic operation of railway converter substations indicated the increasing tendency toward their use for heavy service. At the evening session two designs of electric locomotives for use on the Chicago, Milwaukee & St. Paul Railway electrification were described. The meeting was thus largely devoted to electric railway problems.

One paper, presented by C. M. Davis in the absence of its author, J. J. Linebaugh, General Electric Company, entitled "Short-Circuit Protection for Direct-Current Substations," gave the opinion of the author that flash barriers with arc coolers and a new form of high-speed breaker with current-limiting resistance provided complete protection from a "dead" short circuit. It was said that this new type of breaker had been applied to the new gearless locomotives for the Chicago, Milwaukee & St. Paul Railway. On the other hand, Marvin W. Smith, Westinghouse Electric & Manufacturing Company, in his paper, "Flashing of 60-Cycle Synchronous Converters and Some Suggested Remedies," showed the results of extensive investigations on a 500-kw., 600-volt, six-phase, 60-cycle, 1,200-r.p.m. converter. These indicated that full protection on the alternating-current side may be obtained with a flash suppressor, and Mr. Smith maintained that flash guards increase the tendency of a machine to flash over after they have become carbonized. Furthermore, flashing does not appear to be entirely dependent upon the point or value at which this current is interrupted. Tests with both the low-speed and high-speed breaker indicated that a machine rarely flashes over until the direct-current breaker has opened. For this reason, Mr. Smith said, a moderately high-speed breaker is no better than an ordinary slow-speed breaker. Experiments are now being made on the flash suppressor, consisting of a high-speed switch actuated by the short-circuit current, which short-circuits either all or a part of the collector rings, in the hope of solving this problem completely.

In commenting on these two papers, F. D. Newbury of the Westinghouse Electric & Manufacturing Company reiterated the statements of Mr. Smith to the effect that the moderately high-speed circuit breaker may cause more trouble than the slow-speed breaker. Flashing continues and increases, he said, after the circuit-breaker action has stopped. In regard to the use of flash barriers, Mr. Newbury thought that, although they may be the final solution, they are undesirable from the standpoint of accessibility.

Speaking from the viewpoint of the operating man, C. H. Jones, engineer of the Chicago, North Shore & Milwaukee Railway, stated that the flash barriers had proved successful on his company's 25-cycle converters. Although the converters "squeaked" occasionally from heavy overload current, there had been no flashing.

In his paper, "Automatic Railway Substations," Frank W. Peters, General Electric Company, reviewed the history of this type of station and told of the

advantages of automatic operation. These advantages were set forth by the speaker as follows: Saving of labor, saving of energy, saving at light loads on account of the automatic shutting down of the machines, elimination of building heating with the consequent saving of fuel, simplicity of design, allowing lower initial cost; better load factor, reduction of feeder copper necessary on account of the closer spacing of substations, and reduction of electrolysis losses due to smaller return current.

Heretofore the automatic substation has been confined almost exclusively to small interurban systems, said R. J. Wensley, Westinghouse Electric & Manufacturing Company, in his paper, entitled "Automatic Substations for Heavy City Service," but now it has been shown that automatic operation can be successfully applied for heavy city service. The speaker's figures on such a system showed a total substation cost of $82,693 with a net operating credit of $47,960.

At the evening session, when papers were presented by N. W. Storer, Westinghouse Electric & Manufacturing Company, and S. T. Dodd, General Electric Company, on the two designs of electric passenger locomotives for the Chicago, Milwaukee & St. Paul Railway, it was shown how two entirely different pieces of equipment could be designed to comply with the same specifications. Calvert Townley, Westinghouse Electric & Manufacturing Company and president of the A. I. E. E., sounded the keynote of the discussion when he said that it should be kept in mind that every electrification of steam railroads made thus far has been absolutely successful.

E. H. Sniffin, Westinghouse Electric & Manufacturing Company; A. W. Thompson, president of the Duquesne Light & Power Company, and President Townley welcomed the members in after-dinner speeches in behalf of the manufacturers, the operating companies and the Institute respectively.

In the morning the visitors made an inspection trip through the Westinghouse plant to see the new St. Paul locomotives and the automatic substation equipment. It is said that the attendance was more than 400.

During the morning the board of directors of the A. I. E. E. held a meeting at which, in addition to the consideration of other matters, President Townley was authorized to appoint, after conference with W. S. Murray, a committee for the specific purpose of studying and reporting on the super-power scheme of the Northeastern Atlantic seaboard.

Electrical Safeguards for Pennsylvania Coal Mines

CONFERENCES of state and federal officials, coal operators and manufacturers of electrical equipment have been held recently in Harrisburg, Pa., to discuss changes in the direction of greater safety in electrical equipment in coal mines and the adoption of a code of rules further to safeguard employees and to keep pace with the increasing use of electrically operated machinery in coal mines.

Manufacturers of storage-battery locomotives have agreed to changes in design of their machines to conform to the requirements of the state and federal authorities, and the operators have expressed their willingness to add the safety features to the locomotives already in use. There are now about 300 of this type of locomotive in operation, and it will cost from $400 to $600 each to add the necessary safety features. The chief of the State Department of Mines stated that while the obligation rested on the department to safeguard the miners, there was no intention to be arbitrary or unduly to restrict operators during the period of change-over.

The unfortunate feature of the matter, it is learned from the State Department of Mines, is the deficiency in the mine laws of the state regulating electrical equipment. In the anthracite region the act of 1891 is still operative, and it contains no mention of electricity. The bituminous mine code, passed in 1911, was prepared with much care and effort and at the time was sufficient to meet the demands, but as electricity has so generally replaced steam equipment the bituminous code is also now far behind the requirements. This being the case, certain rules, according to the State Department of Mines, must be adopted to tide over the interim between the present time and a time when a new electrical code can be enacted.

Bureau of Standards Handicapped by Lack of Funds

DR. E. B. BOSA, chief physicist United States Bureau of Standards, addressed the Boston Section of the American Institute of Electrical Engineers on March 2 upon the work of the bureau in the war and after, emphasizing the economic value of research and pointing out that at a conservative estimate every dollar expended for research adds $100 directly or indirectly to the nation's wealth. At present the cost of maintaining the varied and important work of the bureau amounts to about 1 cent per year per capita population of the United States, and if this could be doubled or trebled, the results would be of extraordinary benefit to the people at large and to private industries. The bureau is handicapped by lack of the funds needed to enable it to carry forward its numerous researches upon an adequate scale, and the opportunities before it are almost beyond appreciation, given adequate financial support.

Chicago Electrification Not to Start for Two or Three Years

MANUFACTURERS and trade representatives who are anticipating business to develop from the proposed electrification of the Illinois Central in Chicago will be interested to learn that it will perhaps be two or three years before active construction on overhead or third-rail distribution system and substations can be begun. The reasons which make it necessary to delay starting until this time are that a great deal of track work, building and other changes in physical property must be well under way before the electrification can be started. At the same time purchase of motor cars and other electrified equipment will be begun.

Erroneous ideas as to the date for starting this work have spread among the trade largely because the company is considering at the present time the purchase of a few steel trailer cars which will be later used in the electrified suburban service. Long before the actual railroad electrification is started the job of wiring the new terminal building and other similar buildings will occupy the center of the stage.

Applications to Appropriate 600,000 Hp. in Oregon

AN INDICATION of the great amount of water-power development being contemplated in the immediate future in the West is found in the report of the State Engineer of Oregon, who has received this year twenty-one applications to appropriate water to generate 600,000 hp., or more than three and one-half times as much power as has already been developed. Among applications is one covering the Five Mile Project, to reclaim 100,000 acres in Franklin and Walla Walla Counties and to develop 30,000 hp.

Fourth Electric Battleship Launched

THE superdreadnought Maryland, the fourth capital ship of the navy to be equipped for electric drive, was launched at Newport News, Va., on March 20. The Maryland is sister ship to the California, launched in November at the Mare Island Navy Yard, California. Her electrical propulsion equipment, which is of General Electric Company manufacture, consists of two turbo-generator units rated at 11,000 kw. each, one control board, four 7,000-hp. propeller motors of the induction type and six 300-kw. exciter sets. The capacity of the complete power plant for propulsion is 28,000 hp. In most respects the Maryland's propulsion equipment follows that of her predecessors, the California and the New Mexico. She is the first vessel to mount 16-in. guns, being supplied with a battery of eight and thus possessing a range greater than any other American warship. She is 624 ft. (188 m.) long, displaces 32,000 tons and is equipped to operate at full speed up to 21½ knots (58 km.) per hour.

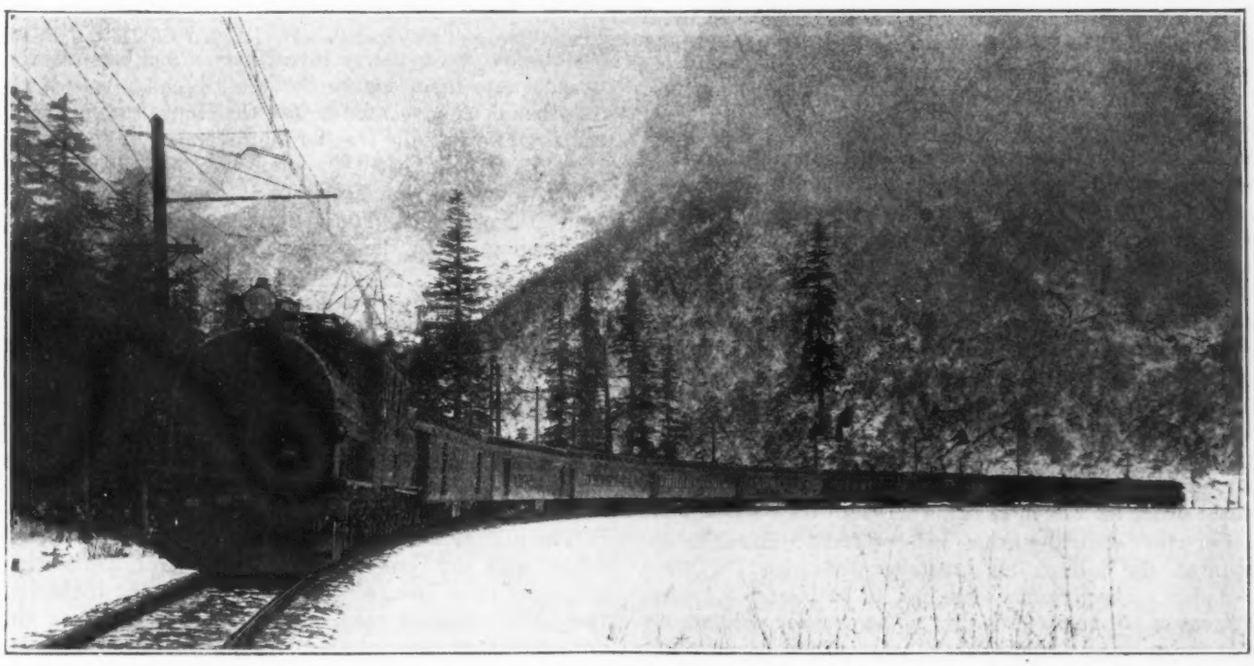
A Plan for Co-operation Between Industry and Colleges

THE Technology Clubs Associated, composed of fifty-eight local clubs of technical men, propose to bring together representatives of American industry and of higher education for the purpose of improving the quantity and quality of trained men for management duty.

According to this plan, it is proposed: (1) That representatives of industry shall specify in as definite terms as possible what types of college men are most needed by industry, what character and training industry requires of these men, how many will be needed and what their opportunities in any particular business are; (2) that a specific statement shall be made by representatives of the colleges giving the extent to which the colleges can meet the demands of industry, that is, telling what courses are now given or can be given to meet these demands; (3) that a joint conference between industry and the colleges shall be held for the discussion of these problems at Philadelphia, March 26 and 27; (4) that a permanent record shall be made in book form of the results obtained; (5) that a permanent plan shall be adopted to provide for the continuance of profitable co-operation between industry and education.

At the annual meeting of representatives of the schools and of the industries each of the co-operators from industry is to give one day of an executive's time to presenting information necessary for the prosecution of the work and each industry taking part in this program is to subscribe $2,500 toward the cost of carrying out the plan. The total sum subscribed will be administered by a financial committee made up of Col. Henry Waite, Lester Gardner and Dr. Hollis Godfrey, who is also president of the Technology Clubs Associated.

First Train Over Newly Electrified Pacific Coast Section of C., M. & St. P. Railway



THE GENERAL ELECTRIC GEARLESS PASSENGER LOCOMOTIVE WHICH IS SHOWN DRAWING THE TRAIN OVER THE CASCADE MOUNTAINS ON MARCH 5 IS OPERATED AT 3,000 VOLTS DIRECT CURRENT. OTHER PARTICULARS OF THE ENTERPRISE WERE GIVEN IN LAST WEEK'S "ELECTRICAL WORLD"

Socialization of Public Utilities Opposed in Massachusetts

UNDER a suggested investigation to be made by the Massachusetts Department of Public Utilities into the possibilities of interconnection and development by the state of all electric generating and distributing facilities, established and potential, it was recently proposed in a bill sponsored by the local branch of the American Federation of Labor to abandon the policy of private ownership and operation of electric utilities and to socialize the entire electric light, heat and power service of the Bay State. Two hearings were given by the legislative committee on public lighting at Boston, but little evidence of any popular demand for state ownership of electric service was forthcoming. L. W. E. Kimball of Boston appeared on behalf of the bill as its principal advocate, and F. G. R. Gordon, Haverhill, Mass., and E. W. Burdett, counsel for the Massachusetts Gas and Electric Association, spoke in opposition.

The bill, which is looked upon in electrical circles as one of the most radical measures of the present session, provides an appropriation not exceeding $300,000 for the inquiry, with a report by January, 1922, embracing a plan for unified ownership, operation and maintenance by the state of all electric plants and systems within its borders, both private and municipal. On behalf of the measure, Mr. Kimball claimed that existing companies are not developing the field efficiently, that prices are unduly high, and that public ownership and development would increase facilities and reduce costs. In a long argument he endeavored to prove that experience with government ownership and operation shows it to conduce to economy. Chairman Nason stated that he had no question as to the desirability of unifying the systems of energy supply, but that when it came to the question of a publicly controlled system, government inefficiency in the operation of utilities during the war had led to a revulsion of feeling on his part, and he was no longer an advocate of public ownership.

Mr. Gordon, secretary of the American Anti-Socialist League and a well-known speaker against government ownership, addressed the committee at length upon the failures of the public operation of utilities in many parts of the world. He pointed out that the tendency toward public ownership is confined to the radically thinking population, but that the disastrous results of government operation of utilities during the war, from the standpoint of service and finance, have convinced innumerable people that private management and ownership are vastly to be preferred. H. O. Garman, chief engineer of the Indiana Public Service Commission, recently stated that the poorest managed utilities in the state are municipally owned, and that the cause is partisan politics. Mr. Gordon admitted that occasionally a successful gas or electric light plant can be found under municipal management, but said that, by and large, 95 per cent of all the socialized industries throughout the world are a monumental failure from every standpoint.

For the central-station interests Mr. Burdett denounced the bill as an unadulterated plan for state socialism on a gigantic scale, not to be tolerated by the citizens of the commonwealth. The speaker pointed out that its passage would lead the way toward overturning all previous conceptions of the proper functions of state government. The centralization of generating and supply systems demanded by the times is going forward effectively under private ownership, under the ordinary laws of business and trade. The government's assistance is not needed. Mr. Burdett said that difference between generating cost and selling price to the small consumer is forced by the cost of service beyond the generating station and the unfavorable demand conditions. He held that the greatest profit is made on low-rate power.

Activities of Engineering Council's National Service Committee

THAT the name of the Washington office of the Engineering Council should be changed to "National Service Department" and that the Washington representative should be designated "national service representative" is recommended in the annual report for 1920 of the national service committee of the council, issued last week. The abolition of the committee is included in this recommended change, the chairman, M. O. Leighton, finding that as at present constituted it serves no purpose, conditions constantly forcing the chairman to act on his own responsibility. There exists also a need to make clear whether the chief function of the council is to offer engineering service to the nation or to offer national service to the engineer.

Among important matters undertaken during the year were (1) bringing about a permanent Board of Surveys and Maps to which the supervision of all government mapping has been given; (2) urging upon the President the appointment of engineers on the International Joint Commission and the Interstate Commerce Commission, such appointment to the latter body having been made but refused by the appointee; (3) advocacy of increased compensation for railway professional engineers; (4) getting into closer relations with Congress; (5) propaganda for the proposed National Public Works Department.

Since the December meeting of the Engineering Council work along the lines just mentioned has been continued, follow-up work on the proposed Boston-Washington super-power investigation has been carried on, adequate maintenance for the Signal Corps of the army has been advocated before the House committee on military affairs, bills for the improvement of the Patent Office have been actively supported, and co-operation with the engineering societies of the capital has been successfully sought. The general work of the office has increased at about the same rate as previously.

Signal Corps Organization Approved by House

ONE of the few sections of the army reorganization bill which was passed over by the House of Representatives without discusson was that pertaining to the Signal Corps. No amendment was offered to this section, which reads as follows:

"The Signal Corps shall consist of one Chief Signal Officer with the rank of brigadier general, 290 officers in grades from colonel to second lieutenant inclusive, and 5,000 enlisted men, such part of whom as the President may direct being formed into tactical units organized as he may prescribe; provided, that during the tenure of office of the present Chief Signal Officer he shall have the rank of major-general."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Pennsylvania Safety Congress.—A safety congress under the auspices of the Department of Labor and Industry of Pennsylvania is to be held from March 22 to March 25 in the State Capitol at Harrisburg. On Tuesday, March 23, there will be a symposium on "The Public Utility and Its Hazard."

Endowment for Worcester Polytechnic.—Twenty-two scholarship foundations of $10,000 each were pledged by local manufacturing concerns recently to the Worcester (Mass.) Polytechnic Institute in the course of a "drive" now under way to endow this noted engineering school with $2,000,000.

M. I. T. Professors to Receive Bonus.—The executive committee of the corporation of the Massachusetts Institute of Technology has voted to appropriate $100,000 as a bonus to the instructing staff, covering the remainder of the academic year. In the fall a new schedule of salaries will be established in view of the success of the recent campaign for an endowment fund of $8,000,000.

Ice and Sand Hinder Operation.—So severe did the weather conditions at the Port Clinton power plant of the Northwestern Ohio Railway & Power Company become during the long cold spell that it was found necessary to blast a channel through ice and sand bars to get relief. Steady winds from the southwest had lowered the water of Lake Erie several feet in front of the company's plant.

Growth of Georgia Company's Testing Laboratory.—The testing laboratory of the Georgia Railway & Power Company, which two years ago was manned by two men whose most important work was the testing of meters, is now equipped to make almost every known electrical test. To it fell the acceptance tests of the 60,000-kw. hydro-electric plant at Tallulah Falls, where the sixth 13,300-kw. turbine is now being installed.

Metropolitan Edison Has Banner Year.—The Metropolitan Edison Company's new-business department reports that 1919 was a banner year, 15,442 hp. being added to the company's load. Two contracts with other public utilities—one the York Haven (Pa.) Water & Power Company, the other the Pottsville (Pa.) company—are not included in these figures. Under an arrangement for interchange of power with the former company 5,000 kw. may sometimes be called for, while the latter company will take from 2,000 kw. to 4,500 kw.

California College Changes Name.—By unanimous action of the board of trustees, taken last month, the name of the Throop College of Technology, Pasadena, Cal., has been changed to California Institute of Technology.

Standardizing Map Making.—President Wilson has created a board of surveys and maps "in order to coordinate the activities of the various map-making agencies of the executive departments of the government, to standardize results and to avoid unnecessary duplication of work." The board is directed to perfect a permanent organization and to hold meetings at stated intervals, to which representatives of the map-making public shall be invited for the purpose of conference and advice.

Lowellville, Ohio, to Have Larger Power House.—The Pennsylvania-Ohio Electric Company, successor to the Mahoning & Shenango Valley Railway & Light Company, is to build a large addition to its power house at Lowellville, Ohio. The improvement, which will cause an expenditure of more than $1,000,000, will involve the installation of a 20,000-hp. turbo-generator of the latest type, increasing the total rating of the plant to 80,000 hp. and affording additional power facilities to the rapidly expanding districts of Youngstown, New Castle and Sharon.

Teaching Safety to Engineering Students.—With the idea of interesting educators in engineering colleges still further in a plan to impart to their students a knowledge of modern safety methods, the National Safety Council recently arranged a conference with prominent engineers and instructors, at which addresses were made by several members of the council. Their suggestions were commented on by Frank J. Sprague, Dean Cooley, Prof. C. A. Adams, Dr. E. P. Rosa and others, who discussed the safety movement from the standpoint of economy and engineering efficiency and also in its human and altruistic aspects.

Utilizing Waste Natural Gas.—The San Joaquin Light & Power Company is preparing to begin work upon a new generating plant in the oil field west of Bakersfield. This plant is planned primarily for the use of natural gas produced in the oil fields and now going to waste because of the lack of facilities for transporting it to the distant market of Bakersfield and Los Angeles. According to A. D. Balch, vice-president of the company, the plans for the plant are about completed. Stirling boilers will be used, equipped with duplicate sets of furnaces so that either natural gas or oil may be burned. The first electrical unit will be a 12,500-kw. generator feeding into the 110,000-volt transmission line. It is planned to install ultimately three other units of the same rating in this plant, making a total of 50,000 kw. Construction will be in charge of E. A. Quinn, general superintendent. The first installation will require approximately $1,000,000, and it is hoped to have the plant in operation this year.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. and S. E. E., Philadelphia Section.—"Welding, Electric Versus Gas," will be the topic presented by James E. Wilson, electrical engineer for the Treadwell Engineering Company, Easton, Pa., before this section on Saturday, April 3.

Pennsylvania Electric Association.—The Eastern Geographic Section of the Pennsylvania Electric Association will meet at Philadelphia on March 25, when "Grounding Secondaries" and "Customers' Appliance Repairs" will be the subjects of discussion.

Engineers' Club of Philadelphia.—"The Progress of the Engineering Council's Work" will be discussed by Alfred D. Flinn at the Tuesday luncheon address of the club on March 30. Next week P. H. W. Ross will talk upon "Merchant Marine Developments."

A. I. and S. E. E., Pittsburgh Section.—Coming meetings of the Pittsburgh Iron and Steel engineers are that of April 17, when Robert B. Treat, electrical engineer, General Electric Company, Schenectady, will present a paper on "Grounded Neutral," and that of June 12, when R. H. Keil, power engineer, Jones & Laughlin Steel Company, Pittsburgh, will discuss "Current Limit Reactance."

Wisconsin Electrical Association.—C. A. Butcher of the switchboard engineering department of the Westinghouse Electric & Manufacturing Company will present the paper on "The Development of Automatic Substation Equipment" which was unassigned in the program published in this column on March 6 for the Milwaukee meeting of this association to be held next Wednesday and Thursday.

A. I. E. E., Boston Section.—On April 9 a meeting of the Institute under the auspices of the Boston Section and the committee on electrochemistry and electrometallurgy will be held at Boston jointly with the American Electrochemical Society. At 9:30 a.m. a symposium on "Electrically Produced Alloys" will be given at a joint session of the two societies. In the afternoon an inspection trip will be made to the laboratories of the General Electric Company at Lynn, where talks on research work will be delivered by Prof. Elihu Thomson and others. At 6:30 p.m. a subscription dinner will be served at the Copley Plaza. At 8:30 p.m. the evening session will be held at the Copley Plaza, where a symposium will be given on "Power for Electrochemical Purposes."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Exercise of Police Power by the State in Changing Rates. — The Supreme Court of Oregon, in a decision just handed down, in City of Hillsboro vs. Oregon Public Service Commission and North Coast Power Company, has ruled that when a city enters into a franchise agreement with a public utility which involves rates for the service rendered the law reads into the contract the stipulation by the city that the state may at any time exercise its police power to change such rates.

Duty of Commission in Fixing of Maximum Rate.—In City of Cleveland vs. Public Utilities Commission, it was held by the Supreme Court of Ohio that when the commission, on the complaint of an illuminating company, set aside as unjust a municipal ordinance fixing a maximum rate of 3 cents a kilowatt-hour for electrical energy and merely fixed as a maximum rate 10 cents—a price concededly too high for an actual uniform operating rate—it was in error and that it was its duty to fix a just and reasonable rate. (125 N. E. 864.)

Contributory Negligence in Case of Death from Fallen Wire.—Whether a man who was killed from contact with electric wires attached to a fallen pole alleged to have been unsafely erected in stock yards where he had duties was warned of the danger, heard the warning if given, or was in a position to hear another deliver a message that the wires were down, and similar questions, with the general question of contributory negligence, were held by the Supreme Court of Iowa, in Eason vs. Des Moines Electric Company, to be questions for the jury. (175 N. W. 945.)

Damages Claimed Because of Dam Erected in 1902.—The Supreme Court of Georgia has held that a non-suit was properly granted in Roberts vs. Georgia Railway & Power Company, a suit for damages because of alleged injury due to a dam built in 1902 below petitioner's property and creating a large reservoir. The court found that there was no evidence to show that the dam was improperly constructed, operated or maintained, that no negligence was charged either against first operator or the defendant, a successor, and that there was nothing to support allegations of foul odors constituting a nuisance and menace to health. (101 S. E. 813.)

Verdict as to Negligence of Several Defendants Conclusive on Appeal.—In a suit brought jointly against a construction company, a telephone company and an electric light and power company for the death of plaintiff's husband it appeared that he was employed by the construction company, which in the progress of work upon a reservoir was responsible for the breaking of a telephone wire that subsequently came into contact with the wire of the power company and thus led to the fatal accident. The trial court found against the construction company and in favor of the two other defendants, and the Supreme Court of Missouri has held that this verdict is conclusive on appeal. (317 S. W. 831.)

Where a Contract Is Unambiguous, Circumstances and Intent Are Immaterial.—The Supreme Court of Montana has held, in Helena Light & Railway Company vs. Northern Pacific Railway Company, that a contract to furnish the defendant with all the electrical energy it required at its pumping station and other places was not broken because of the abandonment of the pumping station, although the inducing cause that led the electric company to make the contract was the use of its poduct at the pumping station. The contract at issue was for five years with option of renewal, but, on the ground that renewal of a part only of the contract was sought, the electric company held that the rate should be increased to that of its regular schedule. (186 P. 702.)

Interstate and Intrastate Commerce in Electricity.—In Mill Creek Coal & Coke Company vs. the Public Service Commission of West Virginia, the Supreme Court of Appeals of that state laid down these among other principles governing the importation and sale of electrical energy: (1) The transmission of electricity from state to state is commerce between the states; (2) in determining when commerce ceases to be interstate and becomes intrastate the essential character or unity of the movement is decisive; (3) the transmission of electrical energy direct from the seller in one state to the consumer in another for immediate or virtually immediate use, subject only to a temporary stop en route for the purpose of reducing the voltage, remains interstate commerce until the commodity has reached its goal unless theretofore sold to independent distributing companies, in the state importing the energy, for resale to local consumers; (4) the regulation of the rates at which electrical energy transmitted from one state to another shall be sold in the latter state is, so long as the rate fixed is not confiscatory or discriminatory against citizens of another state, a matter essentially local in its nature and not of such national importance as to require a general system and uniformity of regulation; (5) reasonable rates for electrical energy prescribed by a state in the exercise of its police power, through the instrumentality of the Public Service Commission, are not repugnant to the contract or due-process-of-law clauses of the United States Constitution. (100 S. E. 557.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Invalidity of Oral Contract.—In the matter of an alleged oral contract for fan service entered into with the predecessor of the Richland Public Service Company and refused recognition by the latter company, the Ohio Public Service Commission decided that it was without power to compel the fulfillment of the agreement asserted to exist inasmuch as to do so would be ordering the defendant company to commit a discrimination, which the law forbids.

What Constitutes Going Value.—The Indiana Public Service Commission has asserted its belief that the logical and equitable basis for an allowance for going value is the unrequited losses and the cost of establishing the business. No substantial allowance for going value is justified where there is no showing of early or unrequited losses or of any capital expenditures for establishing and attaching the business other than those which have been paid as operating expenses without loss or impairment of dividends.

Commission's Policy on Consolidation.—The North Dakota Board of Railroad Commissioners, in passing on an application made by the Dakota Light, Heat & Power Company, has declared itself not to be opposed to the consolidation and merger of public utilities where increased efficiency in administration and operation may be derived therefrom. It holds, however, that no value for purposes of capitalization should be attached to increased efficiency and decreased operating costs resulting from such consolidation.

Power to Compel Consolidation.—The Railroad Commission of Wisconsin has held that it is without authority to compel the consolidation of competing telephone exchanges in a municipality, even though such consolidation would result in economy of operation and lower rates for subscribers. The Ettrick Telephone Company and the Western Wisconsin Telephone Company each operate telephone exchanges in both Ettrick and Galesville. The Railroad Commission recommended a scheme of consolidation which would eliminate one of the extra exchanges in each village. The Western Wisconsin Company agreed to this, but the Ettrick company refused. Ninety per cent of the latter company's subscribers are stockholders, and at the annual meeting they voted unanimously to pay higher rates rather than consolidate. The commission has, therefore, authorized an increase in rates from $12 to $15 a year and established a charge of $6 per year for extension telephones.

F. W. Brownell has been appointed general auditor of the Stone & Webster companies in the Puget Sound district, succeeding F. P. Dexter, who has been transferred to the Boston office.

W. Wayne Everett, who has held the position of assistant sales manager for the last year and a half with the Wisconsin Gas & Electric Company at Kenosha, Wis., and previous to that held the position of sales manager for four years, has resigned to become advertising manager for the *Wisconsin Agriculturist*.

Edward M. Burd and **William C. Giffels** have recently opened an office in Grand Rapids, Mich. Both are University of Michigan graduates and have since had about ten years' experience in power development work, largely in connection with the design and construction of the steam and water-power plants and transmission lines of the Consumers' Power Company system in Michigan. During the war Mr. Burd was a captain of heavy artillery, while Mr. Giffels was first lieutenant of engineers and served more than a year on the firing line in North Russia. Since that time both men have been back with the Consumers' Power Company.

S. W. McCune, Jr., who was for some two years electrical mechanical engineer of the Newport Company, Carrollville, Wis., was recently appointed chief engineer of the company. After graudation from Armour Institute, Chicago, with the degree of electrical engineer in 1910, Mr. McCune entered the test department of the General Electric Company at Schenectady, N. Y. In 1912 he was transferred to the Chicago office of the General Electric Company as sales manager, leaving this post about five years later and becoming connected with the Newport Company. As chief engineer of that company, Mr. McCune is responsible for all new construction and for the maintenance and operation of its electrical and mechanical equipment.

N. J. Neall has re-established offices as consulting electrical engineer at 12 Pearl Street, Boston, Mass., where he is prepared to render special assistance to executives of electrical and industrial properties on plant design, the purchase and operation of equipment, negotiation of power contracts, plant economies and improvements. Mr. Neall closed his offices at Boston in April, 1918, following the completion of his work as consulting electrical engineer at the Camp Devens (Mass.) cantonment. Entering the service with a major's commission, he was ordered to report for duty at Washington, where he was made advisory electrical engineer for the construction division of the army. Later he was made chairman of the committee on the standardization of War Department apparatus and supplies, and his service led to his appointment as chief of the standardization section of the engineering and standardization branch of the purchase, storage and traffic division of the General Staff.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

William States Lee, who is vice-president and chief engineer of the Southern Power Company, with headquarters at Charlotte, N. C., and responsible for the design and construction of the entire system of that company, has built up a consulting practice which has called for the establishing of an engineering office at 511 Fifth Avenue, New York City, to handle a part of his consulting work. He will still retain his relationship as heretofore with the company and maintain his engineering staff in Charlotte which will work in conjunction with the New York office. Mr. Lee will divide his time between these two offices. Some of the high points in Mr. Lee's engineering career are outlined on page 644. He was born Jan. 28, 1872, at Lancaster, S. C., and was graduated from the South Carolina Military Academy in 1894. His first work was with the Pickens Railway Company as resident engineer. That position he gave up to take charge of the construction of the Portman Shoals hydro-electric plant on the Seneca River as resident engineer for the Anderson (S. C.) Water, Light & Power Company. There he placed in service in 1898 the first 11,000-volt generator to be installed in America. After completing this plant Mr. Lee spent some time in construction work for the United States government coast-defense plans for the Charleston and Port Royal harbors. In October 1898 he was employed by the Columbus (Ga.) Power Company as resident engineer on the construction of a dam on the Chattahoochee River at Columbus. This dam was partly swept away by a severe flood in 1900. Its redesign and reconstruction, together with the building of transmission lines and substations, were then placed under his direction and supervision as chief engineer for the company. He modified the design and raised the height of the dam, completing it in the spring of 1902. This was the first large dam built in the South and was constructed under most unfavorable conditions due to quickly rising floods. About this time Dr. W. Gill Wylie, the organizer of the Catawba Power Company, was having trouble in building a dam at India Hook Shoals, near Rockhill, S. C., on the Catawba River, and Mr. Lee was engaged as chief engineer to take up the work that three contractors were unable to complete. In spite of persistent floods he completed the dam in the spring of 1904, together with 47 miles of transmission lines from the plant to Rockhill, Charlotte and Clover. Upon the formation of the Southern Power Company in 1905, which took over the Catawba Power Company and purchased larger power rights on the Catawba and Broad Rivers, Mr. Lee was made chief engineer and in addition served in the executive capacity of vice-president. This position he has ever since held, and with the financial assistance of J. B. Duke, as president of the Southern Power Company, he has designed and constructed the generating stations of that company in the following order: Catawba, 6,600 kva., in 1904; Great Falls, 30,000 kva., in 1907; Rocky Creek, 30,000 kva., in 1909; Ninety-nine Islands, 22,500 kva., in 1910; Lookout Shoals, 22,500 kva., in 1915; Fishing Creek, 37,500 kva., in 1916; Bridgewater, 25,000 kva., in 1919, and Wateree, 70,000 kva., in 1919. Four auxiliary steam stations have also been built, with a total rating of 36,500 kva., making the combined generator rating of all plants 280,900 kva. These stations serve 2,050 miles of high-voltage transmission lines and through outdoor substations with a combined rating of 443,500 kva. furnish electric energy to one-fourth of the number of spindles in the cotton mills of the South. Under Mr. Lee's direction also 130 miles of high-speed electric railway, operated at 1,500 volts direct current from the Southern Power Company's system, was built and placed in operation in 1911 for general freight and passenger traffic. The standards devised by Mr. Lee through experiences in pioneer design and installation of steel tower transmission lines, outdoor switching and transformer stations, line insulation and protection and the design of dams of concrete and earth construction to resist unusual stream flow, have been widely reflected in the practices of other large companies. Mr. Lee is a fellow of the A. I. E. E. and a member of the A. S. M. E., A. S. C. E., Engineering Institute of Canada, and Southern Manufacturers' Club. He is also a member of the Industrial Committee of North Carolina and during the war served on the North Carolina State Council of National Defense.

Obituary

Henry Smith Carhart, celebrated physicist and noted authority on electrical subjects, died at his home in Pasadena, Cal., on Feb. 12. Dr. Carhart was born at Coeymans, N. Y., March 27, 1844. He was graduated from Wesleyan University with the class of 1869 and then took up graduate study at Yale and Harvard and also in Berlin. In 1893 he was a member of the International Electrical Congress which standardized the Clark cell. From 1872 to 1886 he was professor of physics at Northwestern University, leaving in 1886 to become professor of physics at the University of Michigan, where in 1889 he started the College of Electrical Engineering.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Unfilled Orders of Somewhat Uncertain Value

ORDINARILY a volume of unfilled orders is an indication of strength. The greater the amount the better the manufacturer feels. If such were an unerring rule for confidence, then conditions today would be the best ever known.

Electrical manufacturers of standard lines and of specialties, of wiring supplies and of appliances, of motors and of fixtures, all along the line are producing all that they can and in most instances only to find that unfilled orders continue to pile up. Furthermore, these goods are being absorbed by the ultimate consumer as fast as they can be delivered. Satisfactory stocks in a majority of electrical lines are virtually unknown in a large part of the country. There are sections, of course, like the copper-mining regions that are purchasing very little; but these sections only serve as exceptions to prove the rule.

Apparently, therefore, the present situation in the electrical market is decidedly favorable. Still, there is an undertone in the market that is unmistakable. Where six months ago one would say jokingly, "This can't keep up forever," today market students are counseling watchfulness. Cancellations of orders are expected. It is well known that a substantial part of the present volume of unfilled orders represents protection. In fact, in some raw-material markets no secret is made of this fact. Buyers feel that in placing orders today they have nothing to lose and everything to gain. They feel no obligation to accept delivery. If conditions change so that instead of there being a shortage the supply will equal or be greater than the demand, then they expect to cancel.

When such a situation exists the volume of unfilled orders naturally cannot be considered so favorable. In fact, electrical manufacturers are finding this volume of such uncertain value in their assets sheet that they are hesitating to engage in any plan for expansion. There is no doubt that under ordinary conditions the demand and shortage of supply would warrant almost any electrical manufacturer in materially increasing production facilities. Today, however, caution is being urged.

Delivery Conditions Prevailing in the Motor Field

DELIVERIES of motors at present are running around ten to twelve weeks from the factory on direct-current motors in a representative case; from twelve to twenty-six weeks on alternating-current motors up to 20 hp., and from fourteen to twenty weeks on large motors, say of 50 hp. and up. Factory stocks are confined to motors in process and long since mortgaged by purchasers or else awaiting shipment immediately that transportation becomes available. The delays in raw-material shipments and in factory deliveries due to adverse weather conditions are still very trying, but these are temporary in character and less serious than the lessened production resulting from unsatisfactory labor conditions. Unwillingness to work steadily and well for a full weekly schedule is proving a great hindrance to motor output, and in some winding rooms only four days work per week is being obtained. The labor turnover is also disquieting, and the pressure for higher wages is continuous, notwithstanding the unprecedented compensation now widely in vogue. These conditions are naturally putting a premium on the development of labor and time-saving machinery for motor production, and the advances of the past two or three years in this direction are little short of a revelation to an outsider permitted to visit a large-scale motor factory.

It seems probable that no protracted shut-downs will be necessary to motor manufacturers on account of the non-arrival of materials, and that if the industry reaches the close of this month safely, the rest of the year can be utilized with little fear of curtailment. The stability of the present price level seems assured, at least for several months. Within the past few weeks motor prices have advanced or been readjusted on the order of 5 to 10 per cent, and some of these new lists were sent out only after the utmost effort was made to hold to the former schedules. Large buyers of electrical machinery have expressed appreciation of the fact that since 1914 price advances have been of the order of 65 per cent compared with increases of 85 to 315 per cent in many other manufactured commodities. If labor can be induced to "play the game" fairly and squarely in the coming months and years, either by persuasion or by the stern teaching of economic adversity, the effect on motor production will be most salutary, and in any case the use of automatic machinery will be encouraged considerably.

Better Business Methods Bring Added Discounts to Lamp Agents

DISTRIBUTION through consignment of stock to agents always presents many problems largely of a psychological or human nature. The human being is so constituted, unfortunately, that he is prone to think that because he has no money invested in a stock there is little necessity for selling that stock on what is generally recognized as a good business basis.

For some years the bulk of the incandescent lamps made in the United States have been distributed on a consignment basis. In the trade there is the jobber or B agent and the dealer or A agent, who is served on consginment by the B agent. Now this B agent serves customers direct as well.

One of the well-recognized functions of a jobber is to warehouse stocks. In fact, in most lines a large proportion of his discount compensation is made for this reason. However, there have been electrical jobbers, many of them in fact, who, feeling the burden of warehousing charges, made use of manufacturers' local stocks. The jobber would secure an order and have the order shipped to the customer from the manufacturer's stocks.

This situation when brought home to jobbers who performed their rightful function of warehousing showed them conclusively that they were being placed at a disadvantage.

The lamp manufacturers, on the other hand, easily saw that they were being called on to do what they were expecting the jobber to do. The manufacturer found that it was costing him more to do this shipping of small lots.

To penalize a jobber for billing from manufacturer's stock by lessening his discount was not felt to be advisable. Another and more generous method was conceived and has been made a part of the 1920 Mazda lamp agent contracts. Now a jobber is allowed an extra 2 per cent on the list value of the lamps which he distributes from his own stocks. The added profit to be derived gives the jobber a greater incentive to warehouse lamps.

A greater evil in the distribution of lamps, however, is

that of slowness of turnover. On consigned stocks naturally there is not the incentive to increase turnover that there is on sold stocks. In the lamp situation there is the added complication of the jobber consigning stocks to the retailer.

Consequently, the manufacturers in their 1920 contracts gave the jobber the definite responsibility of seeing that the dealer turned his lamp stocks over at what was felt to be a reasonable rate. The retailer's stocks are actually in the custody of the jobber. Under the old contracts the jobber received a flat 5 per cent on the list value of the retailers' (A agents') sales. Under the new contract, as originally drawn up, the jobber or B agent was to receive instead 3 per cent with an additional 1 per cent if the A agents showed a turnover of five times a year, and an additional 2 per cent if the A agents showed a turnover of six times a year.

While the manufacturers feel that such a rate of turnover is reasonable and practicable, there have been a number of jobbers who were not so convinced. Rather than force these terms on the jobbers, almost, as it were, without warning, the lamp manufacturers in a statement to the ELECTRICAL WORLD said that for the current calendar year they had decided to pay the full 5 per cent, regardless of the turnover rider, with the distinct understanding, however, that they were convinced of the fairness of the principle and were definitely going to put it in force on some equitable basis in next year's contracts.

The manufacturers of lamps have now out on consignment millions of dollars worth of lamps. This investment is bringing in no return. It is not unreasonable to suppose, therefore, that if this huge unproductive investment can be materially reduced by increasing turnover the distributer who aids in this matter will find the manufacturer more inclined to better his discount.

The manufacturers state that they are firm in their decision to make stocks move faster. It was for that reason that they decided to make the discounts such that the jobber will have a real incentive.

Pole-Line Material Prices Are Materially Higher

AN INCREASING demand is felt for pole-line material with the approach of the spring construction season. Generally speaking, stocks are in fair shape—much better, in fact, than stocks on other electrical materials.

Prices have advanced on almost all line material except wire. White cedar poles are up 10 per cent, cross-arms 8 per cent, insulators 10 per cent, hardware 10 per cent, and locust pins 25 per cent.

Cross-arms appear to be short east of the Rockies. It is reported that the Pacific Coast yards are piled high with cross-arms, but owing to a local shortage of rolling stock it takes from three to six weeks to make a shipment.

Sales Efforts in Industrial Heating Intensified

IN ORDER to take fuller advantage of the opportunities presented in the industrial heating field, at least two large manufacturing companies have recently intensified their efforts in that direction. It was only in January that the Cutler-Hammer Manufacturing Company announced the discontinuance of its domestic heating line to permit it to apply all its energy of that nature to developments of the industrial heating field.

The New York office of the General Electric Company has just organized a "process section," composed of men specializing in equipment such as is used in electrothermal and electrochemical operations, to centralize the handling of equipment for special processes wherein electricity or electrical heat is the active agent. This has apparently been done in view of the situation prevailing in the metropolitan district, where headquarters of many of the large manufacturing, mining and reduction companies may be found, companies which are or could be large users of this kind of energy.

Reducing Lamp Shrinkage by Means of Bonus

IN THE manufacture of incandescent lamps the reduction of shrinkage is perhaps the most serious problem encountered, and lamp makers are concentrating attention upon this matter. The percentage of spoiled or rejected lamps in process expresses in some cases the difference between commercial success and failure, and in the past a number of companies have gone on the rocks because of excessive losses of this kind. Of late, the paying of a bonus dependent upon the reduction in shrinkage percentage has come into favor in certain lamp factories, and the results appear to justify the practice. The lower the shrinkage the more the employee earns, and the application of what might be called profit-sharing methods to the pursuit of a shrinkage "bogie" is cutting down spoilage and waste.

What such profit-sharing means is illustrated in the case of automatic exhausting, where a typical operator is paid $4.25 for exhausting 5,000 lamps with a shrinkage of 3.1 per cent and $5 if a shrinkage of 1 per cent is obtained. To make headway in approaching or attaining a shrinkage bogie, inspection must be maintained at maximum efficiency and poor work must not be allowed to be passed along to the next operation to add to the shrinkage of the succeeding process. The ability of lamp manufacturers to meet the growing demands of the trade is intimately bound up in these important problems of production efficiency.

Lightning-Arrester Deliveries Good

MANUFACTURERS are better able to deliver lightning arresters than almost any other kind of equipment. Although sales have been fairly heavy, greatly increased production has enabled manufacturers to get some stock ahead. This, however, it is expected, will be swallowed up by the first rush of orders. As the heavy buying of the year takes place during the spring months, production of arresters is being pushed to the limit in an attempt to keep ahead of orders placed.

Distribution lightning arresters, both of the compression-chamber multi-gap type and of the aluminum-cell type for 2,300-volt service, are in fair demand. Ample stocks of each kind are held ready for shipment. In the larger sizes of compression-chamber multi-gap arresters deliveries are four, eight and ten weeks respectively on voltages of 5,000, 7,500 and 15,000. Arresters of special design require four to six weeks additional.

In the high-voltage transmission field deliveries on both aluminum-cell and oxide-film arresters range from two to eight weeks, depending upon size and type.

Prices have not changed since last fall with the exception of a small increase on compression-type arresters. The oxide-film arresters, however, have been decreased in price, on an average 5 per cent. According to the manufacturer, the decrease was made because of greater production and increased sales.

More Interest Being Shown in Grounding Device Sales

SALES of grounding devices for a year past have been rather spotty among various manufacturers. Where labor conditions have permitted operators to work their plants at full capacity an increase in business has been shown for the year. Where labor conditions hindered production inquiries received by the manufacturers indicate that the business of the year just closed would otherwise have been above that of the year previous. Ability to furnish the grounds has been a big factor in the sale, in addition to more settled conditions and more liberal buying in this country and, particularly, the demand that has been growing abroad.

Current sales show an increase. Since the time to manufacture these devices is small, shipments can be made promptly, or up to three weeks. In some cases, however, labor conditions are drawing out this time considerably.

So far as can be learned, prices have not changed recently and there is no prospect for any change in the near future. The outlook is bright because of the quantity of inquiries and the amount of unfilled orders. There is an increasing interest in the problem of proper grounding, and considerable attention is being directed toward adequate capacity, durability and dependability of the apparatus.

As spring advances and frost conditions disappear considerable development in this field can undoubtedly be expected both for new developments and rehabilitation work.

Wood-Pole Market Improving

WOOD-pole sales are improving. Business is encouraging and as soon as the railroads recover from the effects of the storm conditions over the country, deliveries will be much better than for some months past.

Although cutting operations have been difficult during the present season, the work is pretty well along, and were it possible to get transportation at the present time, the distributing yards of the different pole companies would be full to overflowing. As it is the poles have been cut and are on the ground waiting to be shipped. Car shortage is the greatest menace, although in some instances pole interests have built their own flat cars for moving poles to the main line of the railroads. Some stocks already have been received, and a large amount of poles are now loaded or en route.

Prices on red cedar poles have not advanced since the first of the year, but white cedar prices have just increased ten per cent. There is a large demand in the East and South for both Northern and Western red cedar and also for Northern white cedar. In the West the greatest demand is for Western red cedar, which is cut in the off season and is in reality a local product obtainable on short notice at almost any time of the year.

Chestnut poles have not advanced since last year, but an increase is now looked for and may be announced at any time. Some of the best grades grown in parts of Virginia and Pennsylvania have been destroyed by blight although there is a considerable supply south of these districts which will be available.

Metal Market Situation

A CONTINUED dullness in metals was evidenced this week. Copper is still going down, being an eighth of a cent lower than last week. London prices continue to toboggan. Copper consumers from all reports seem to be fully covered until the first of May. Current sales are small and are for the most part resales. Producers, it is stated, are not interested in present prices, claiming that they are too low. Producers are holding prompt to third quarter copper, it is reported, at 18½ cents, which is slightly in advance of open-market quotations.

Seamless-copper tubing is quoted at 32 cents and seamless high-brass tubing at 30½ cents. Copper sheets are quoted at 29½ cents and round rods at 26¾ cents.

Old metals showed little change over last week.

NEW YORK METAL MARKET PRICES

	March 16	March 8
Copper	£	£ s d
London, standard spot	107.00	121 0 0
	Cents per Pound	Cents per Pound
Prime Lake	18.50 to 18.75	18.75
Electrolytic	18.12½	18.25
Casting	17.87½	18.00
Wire base	22.25	22.25
Lead, trust price	9.25	9.25
Antimony	11.00	11.37½
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.00	12.50
Spelter, spot	8.85 to 8.95	8.85
Tin	62.00	61.50
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.50 to 16.00	16.50 to 17.00
Brass, heavy	10.00 to 10.25	9.50 to 10.00
Brass, light	8.50 to 9.00	8.75 to 9.00
Lead, heavy	7.75 to 8.00	7.75 to 8.00
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

SUSTAINED heavy demands and unusually slow transportation have combined to produce the worst shortage of electrical supplies on record. Local conditions are apparently worse today than during the height of the war. Total absence of a growing list of items is reported from more than one locality.

Prices seem to be steady, however, porcelain insulators, cross-arms, locust pins and line hardware are reported up.

Collections are slowing down here and there, but apparently this condition will right itself very shortly. At any rate, it is causing no concern in those localities yet.

NEW YORK

The past week has shown considerable improvement in shipments over previous weeks. A good many carloads of material were received only to be rebilled and sent out to dealers. With the exception of some seasonable goods, jobbers are rebilling virtually everything they receive; hence the amount of goods sent out is smaller in volume than is usual. Parcels post is being used to a great extent, and materials such as porcelains, etc., are reported as coming through in good shape.

Jobbers, not to be caught short of heating appliances for the Christmas trade, are placing orders for both 1920 and 1921 requirements.

Lack of labor and of raw material, with an added car shortage, is holding up rigid conduit and armored flexible conductor. One manufacturer reports that he has not made any of the latter for five weeks as the raw material is still en route.

Wire.—Deliveries are much better in this line than on many other products. The demand is brisk and stocks are moving rapidly. Rubber-covered No. 14 is quoted at $11.50 per 1,000 ft. in 5,000-ft. to 1,000-ft. lots. One large manufacturer on a 26-cent base has revised discounts which increases prices approximately 5 per cent.

Flexible Armored Conductor.—Shortages are reported everywhere. Prospects are for a continued shortage. Manufacturers announce that they cannot get steel strip although many carloads are en route. The price of No. 14 double-strip is $97 to $99 in 1,000-ft. lots.

Sockets.—Prices vary slightly with the demand fairly heavy. Pull sockets during the early part of the week were 47 cents net, keys 28 cents and keyless 26 cents.

Heating Appliances.—Several cars were received the first of the week on old orders. Factory conditions are improving slightly.

Friction Tapes.—Stocks are spotty. The ¾-in. black is 48 cents a pound for lots of 50 lb. or more, 48 cents for from 25 lb. to 50 lb. and 50 cents for quantities less than 25 lb.

Ironing Machines.—Poor shipments are the rule. Manufacturers are now four to eight weeks behind in deliveries. The large demand has been a surprise to jobbers, who are now buying in carload lots.

Schedule Material.—This is coming in stronger with prospects of having sufficient to take care of most of the remodeling work being done. New construction work may have to wait, although there is not so much of it as yet.

Rigid Conduit.—The situation is unimproved and seems to be growing more serious. Considerable relief is expected within three months according to reports, but by that time new construction work and remodeling will take every available foot and still leave a large shortage.

Fans.—These are coming in at a fair rate. Several jobbers report a carload or two, which a month from now

should last probably three days to a week. In view of the raw-material situation, the demand for fans this summer is expected to be unprecedented. Some jobbers already have doubled their orders to be sure of getting at least half of them.

Transformers.—One of the largest manufacturers has advanced prices on all transformers approximately 10 per cent, on account of increased costs of raw material. Deliveries for distribution type, range from delivery out of stock up to four weeks. High-tension transformer deliveries are quoted from ten to twenty weeks.

CHICAGO

Market conditions here remain as for some time in the past, with a great volume of orders pouring in, back orders steadily increasing and prices trending upward. Deliveries are apparently as bad as ever, and the list of items on which jobbers are accepting orders for shipment at manufacturer's convenience and at prices prevailing at time of shipment only is steadily growing.

The motor situation is probably the worst in the entire line. Factories have for some time been congested with orders and troubled by transportation difficulties, and now the acute shortage of magnet wire further complicates matters. One large manufacturer reports now on order more than 50,000 motors above fractional size, and the number of fractional size needed will run well toward the million mark.

Although the holiday season has passed, factories are not rapidly catching up on shipments as was expected. Jobbers report that deliveries are about negligible, and many dealers who in the past have carried but one line are being compelled by pressure of retail demand to take any make they can secure. Jobbers are booking orders on an open-price basis only.

Bare Copper Wire.—This is one of the few items on which deliveries are anything like normal. Dealers are quoting for immediate delivery on a 23-cent base.

Magnet Wire.—Stocks have ceased to exist. No changes have as yet been recorded in price, but orders are being booked only at price ruling on date of shipment. Deliveries range from four months up, with no signs of betterment. A large jobbing concern reports orders totaling nearly $1,000,000 on which delivery ranges from six months to a year.

Snap Switches.—Jobbers report a heavy demand for stock and for current needs. No recent price changes are recorded. Deliveries are slowing up, a month being average at present.

Motors.—Price increases which have been expected became effective this week on certain types and styles of General Electric motors. The raise of approximately 5 per cent is such as to bring into line those items on which the price was below the existing scale.

Batteries.—New list on Hot Shot batteries, on which a raise was announced last week, is as follows: Nos. 1461 and 1462, $2.70 each; No. 1561, $3.25 each; No. 3462, $7.40 each. There has been no change on dealers' discounts.

Poles.—The increase reported a week ago affected Northern white cedar only. Western red cedar prices remain as formerly. Current list on this grade is: For 6-in. poles, 30-ft., $7.90; 35-ft., $11.45; for 7-in. poles, 30-ft., $10.10; 35-ft., $13.25.

Cross-Arms.—An advance averaging 8 per cent became effective on cross-arms last week. Price on 6-ft. Washington-fir six-pin arms, 3½-in. x 4½-in., is now $123.90. Dealers are able to make immediate delivery on reasonably sized orders.

Insulators.—An increase of about 10 per cent is announced on all grades and sizes of porcelain insulators, but actual figures on the new lists are not yet available. There has been no change noted on glass or composition. Deliveries are fairly prompt.

Locust Pins.—At least one large manufacturer has just announced an increase of about 25 per cent. Only those who are protected by contract are able to maintain stock.

Line Hardware.—All items in this line have just been subject to an advance of approximately 10 per cent. Current list on hot-galvanized cross-arm bolts, ⅝-in. x 4½-in., less than 500, $3.78 per 100; over 500, 3.36 per 100; on ½-in. x 7-in., less than 500, $7.28 per 100; large quantities, $6.47 per 100. Hot-galvanized flat cross-arm braces, 1⅞-in. x ⅛-in. x 28-in., less than 500, $163.80; over 500, $145.60; 1¼-in. x ¼-in. x 28-in., less than 500, $201; larger quantities, $178.66.

Fans.—Wholesalers report about 90 per cent of their anticipated 1920 stock already on order, at prices approximating 20 per cent over last season. Current list on 12-in. fans is $28; 16-in., $33.

BOSTON

Orders continue to flood New England jobbing houses. Transportation conditions have improved somewhat, and some jobbers report receipt of carload shipments from the Middle West. Others state that material and supplies shipped three months ago are still en route. The shortage of materials resulting from bad weather has begun to hamper collections from some of the electrical contractors, as much construction work has been temporarily suspended. Prices hold fairly firm. Stocks are very spotty and are badly hit in regard to non-metallic flexible conduit, porcelain and motors up to 50 hp. Rigid conduit is very scarce. New building programs are still going forward actively as regards the placing of contracts. Deliveries show little real improvement, but present famine conditions in various lines are expected to yield to better weather. The Lowell (Mass.) Electric Light Corporation will add a 12,500-kva. turbo-alternator with boiler-plant equipment to its facilities.

Electric Coal Loaders.—The Conant Machine Company has increased prices 10 per cent.

Wire.—Weatherproof in smaller sizes is reported short in some agency circles, but jobbers are reasonably well supplied. Quotations are firmer, running around 32.75 cents per pound for triple-braid, No. 10. Bare wire is easier, at 22.25 cents base, and rubber-covered No. 14 is steady at $11.50 per 1,000 ft. in lots of 5,000 ft. and over.

Non-Metallic Flexible Conduit.—The market is almost cleaned out, so far as quantity sales go. Prices are steady at $37 per 1,000 ft. for ½-in. and $40 for ¾-in. loom.

Metallic Flexible Conduit.—Prices are quoted with 10 to 15 per cent off, when any of this material can be had.

Flexible Armored Conductor.—Stocks are very low. A nominal quotation Monday was $100 per 1,000 ft. on single-strip No. 14 in coil lots.

Knobs and Tubes.—Nail-it knobs are extremely scarce, but are quoted around $28 per 1,000 for estimating purposes. Three-inch tubes bring 93 cents per 100 in standard packages. A few can be picked up.

Rigid Conduit.—Shipments are far below normal, and stocks are hoarded to the limit for old customers. One jobber reports receiving two or three carloads in the past six weeks. Black pipe, ¾-in., brings $85.43 per 1,000 ft., and the same size galvanized $90.53. Fittings are coming through a little better, on about three months' delivery.

Sockets.—Conditions are decidedly better, notwithstanding heavy orders. Manufacturers are not obliged to work nights to any great extent as yet. Prices are steady, with pulls 47.5 cents, keys 28 cents, and keyless sockets 26 cents net, in case lots.

Washers.—Deliveries out of stock are still being made by leading distributers, but only as a result of far-sighted ordering. Prices are firm, a leading make retailing at $150 in galvanized and $165 in the copper-lined tank.

Radio Apparatus.—Sales are very brisk in both amateur and commercial products. Mail-order business is an important factor in current radio supplies.

Meters.—Jobbers' stocks are low in size, but now and then meters can be delivered at once in moderate quantities. By and large, there is a general shortage.

Lamps.—Strict control of deliveries is being practiced. Business is still very active.

ATLANTA

In spite of the street railway strike in Atlanta just ended, jobbers report that there is no slackening in demand for electrical construction material. Outside of Atlanta proper brisk demands are being registered in all lines of electrical material and apparatus. Building permits continue to be taken out in large quantities and rural districts report considerable activities with the opening of the spring season. Complaints of inability to obtain material are becoming more pronounced. Jobbers report collections not quite so good as in former weeks, but even so, accounts are being liquidated with reasonable promptness.

Wire.—Stocks continue to shrink, especially in the popular sizes, Nos. 6, 8 and 10, No. 14 being especially hard to obtain in quantities. Demand on the larger sizes is reported as somewhat easier. Prices are steady, with rubber-covered on 28-cent and weatherproof on 29-cent base.

Conduit.—There are no stocks of 1-in. and ¾-in. rigid in the territory, while the amount of the other sizes is very small. Car shortage is contributing to the difficulty of obtaining shipments, some pipe having been recently received in refrigerator cars.

Cross-Arms.—The brisk spring demand for line material is badly depleting stocks. For the first time in several years, one of the largest jobbers reports no 6-ft., six-pin arms in stock, while the demand for other popular sizes is in excess of the supply. Prices in Rainier Washington fir, 4-ft., four-pin, less than 1,000 linear feet, $1.03; six-pin, 6-ft., $1.60; pine, four-pin, 4-ft., $0.72; six-pin, 6-ft., $1.10.

Non-Metallic Flexible Conduit.—The scarcity is still acute with no hope for betterment in the face of the brisk demand and very poor deliveries. Prices, however, remain steady; ½-in., lots of 250 ft. to 1,000 ft., $3.80; ⅝-in., $4.14.

Panelboards.—Demand is active, while shipments are reported poorer.

Schedule Material.—Local stocks are becoming badly depleted. There is a keen shortage of sockets. Back orders for such have absorbed all shipments recently received. Porcelain is still very scarce, there being practically no knobs or tubes in the territory. An average price advance of 20 per cent is to be noted in this line.

Safety Switches.—Demand is excellent, and, contrary to the general rule, stocks are reported in fair condition. Prices on 30-amp., two-wire, less than one-fifth standard package, $2.20; 30-amp., three-wire, in excess of one-fifth standard package, $2.70.

Oil Switches.—Industrial-plant activity is causing a very brisk demand for the 220, 440, 550 and 2,300-volt, three-pole, single-throw types. Deliveries are slow, particularly on the automatic type, shipments being quoted at from four to six weeks. A price of $76 is quoted on 100-amp. and 200-amp., three-pole, single-throw full automatics.

SEATTLE—PORTLAND

Never have stocks been in the condition that they are today. There are shortages along all lines. There is a particularly good demand, and replenishments appear to be out of the question, orders must be placed from a month to eight months ahead, and then delivery is not assured. The shortage is felt more keenly in house-wiring devices, domestic appliances, schedule material, small motors and porcelain. Apparently there is no relief in sight. In Seattle and Puget Sound cities, the demand for electrical materials for new construction continues increasingly strong, both in the cities and in the smaller suburban towns. Demand for labor-saving devices also is far in excess of available supply, and this condition is true from curling irons to ranges. Jobbers are further harassed by an extreme shortage of competent help, particularly office assistants, salesmen and warehousemen. Owing to the closing down of steel shipyards, there is an over supply of both skilled mechanics and common labor. The spring exodus of labor from the cities to the woods and farms is well under way, and the present surplus will shortly be absorbed. Canneries, sawmills and like industrial plants all expect 1920 to be their biggest year and are making plans accordingly.

The Portland district reports that jobbing and manufacturing interests speak of materially decreasing sales. This may be partly due to the difficulty in obtaining many items. The retail electrical business, however, is in splendid shape, running 50 per cent greater than it did a year ago at this time. As an indication of the movement in labor-saving devices, the Pacific Power & Light Company sold more than 200 washing machines in a campaign conducted during February. A great deal of interest is being developed throughout Oregon in the matter of improved lighting conditions.

Porcelain.—In the face of daily increasing demand, stocks are run down to nothing and no deliveries.

Lamp Cord.—If present demand continues, and there is every indication that it will, stocks will be entirely depleted within a very short time. Shipments are very indefinite. Prices during the past few months have fluctuated.

Flexible Metal Conduit.—Demand is showing a constant increase and stocks are diminishing. Prices are steady. A delayed shipment recently received relieved the local situation temporarily.

Washing Machines.—There is an unprecedented demand and a chronically inadequate supply. Stocks of 32-volt motors for electric washing machines, are completely exhausted.

SAN FRANCISCO

Building permits fell off about 30 per cent during February but are increasing during March. They cover dwellings principally, with here and there a larger job. Rains continue and are spaced so that the year promises well after all. It is predicted that $5,000,000 worth of electrical appliances will be sold in 1920 along the Pacific Coast.

Cross-Arms.—Stocks and sales are improving. The following prices may be considered as representative for delivery from jobbers warehouses: 3¼-in. x 4¼-in. x 5-ft. four-pin light power arms, $1.20 each; 3¾-in. x 4¾-in. x 5-ft. four-pin heavy-power arms, $1.50 each; 2¾-in. x 3¾-in. x 5-ft. six-pin telephone arms, 92 cents each. In lots of several hundred for one delivery these prices may be bettered about 5 per cent. They represent, however, an increase of about 20 per cent over the first of the year.

Fixtures.—Fixtures of the Brascolite ceiling type are in excellent demand because of the redesigning of stores and the improving of residence lighting. Stocks are poor.

Portables.—Fixture dealers report a remarkable increase in the call for stand portables. Comparatively few of the old suspension type, such as were used over dining-room tables, are being sold. There is a decreasing demand for small table brackets and portables except of the very ornate sort. There has been a 20 per cent increase in the Pacific Coast prices of several standard makes of brackets.

Hospital Systems.—This business now seems stagnant after the war activities. There are one or two prospects for railroad hopsitals on foot, but only for a limited number of stations. No Pacific Coast stocks are carried except for maintenance, and sixty days' delivery is promised. The discount on the Bryant type has decreased from 20 per cent to 10 per cent Coast delivery.

Switches.—The best-selling schedule device now is the push switch and plate. One local manufacturer's representative reports that he is 30,000 to 40,000 pieces behind in delivery. Another representative who recently received a shipment of 40,000 push plates sold them within a few days. The call for snap switches is gradually receding.

Flush Receptacle.—The next most popular schedule device is the flush receptacle, which from present indications will outsell even the push switch by the end of the year. A local agent reports that he is about 30,000 behind and is quoting on a basis of from three to four months' delivery.

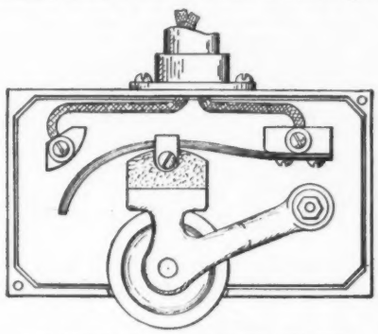
Sewing-Machine Motors.—During the past month or so a great increase in the sale of special bracket motors is noticeable.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Elevator Door Contact

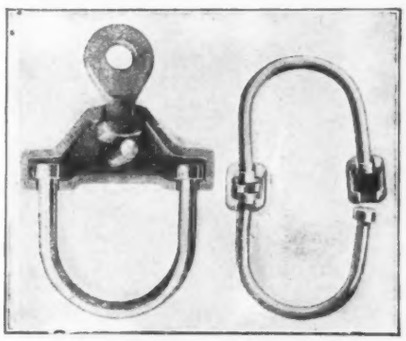
An elevator contact to prevent starting the elevator when any shaft door is open has been developed by Coote & Lawrence, 27 Warren Street, New York City. The device consists of a swinging arm carrying a laminated copper contact which closes when a wheel projecting from the base of the device is pushed inward by the door. The swinging arm is made heavy as it operates by gravity when opening the circuit. The closing operation gives a wiping contact to insure clean surfaces.



CLOSING ELEVATOR DOOR CLOSES CONTROL CIRCUIT

Connector for Link-Type Insulators

A new form of metal connecting link which may be used to join Hewlett strain insulators into strings has been developed by the R. Thomas & Sons Company, East Liverpool, Ohio. The U-shaped member of this connector which is passed through the hole in the insulator has enlarged cylindrical ends with square shoulders which take the strain of the pull on the insulator. Two of these members are used to link two insulators together. After they are placed in the insulator holes their ends are abutted and a coupling piece is slipped over the ends. The ends are then separated about ¼ in. and a locking spring is inserted which prevents them from coming out of the coupling piece. For connecting the top insulator a clamp (one design of which is shown in the illustration) with an eye for attaching to the cross-arm holds the metal link.



MEMBERS CANNOT SEPARATE WHEN LOCK SPRING IS INSERTED

Slip-on Reed Shades for Portable Lamps

Hatheway & Knott, Inc., of 120 Liberty Street, New York City, agents for the Rattan Manufacturing Company of New Haven, Conn., announce the addition of a new feature to their line of "Rattan" portable lamps, in the slip-on reed shades. These reed shades are detachable and can be used on other portables and over different silk shades. They are made in a number of styles and shapes, with both open and closed top. The finishes are numerous.

Linemen's Safety Blanket

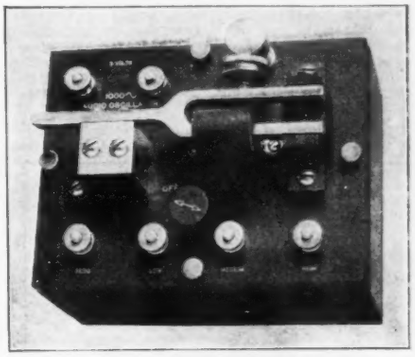
An insulating blanket designed to protect linemen and others from coming in contact with adjacent live lines and terminals has been put on the market by the F. A. Hardy & Company of Chicago and is known as the "Harco linemen's Blanket." It is composed of two thicknesses of steam-cured rubber between which a piece of fabric is inserted. All are vulcanized together in one solid sheet 36 in square, with heavy beaded edges. The total thickness of the blanket is $\frac{1}{16}$ in., and it is made to withstand a test of 25,000 volts. The blanket is to be placed over transformer terminals or live wires with which workmen might inadvertently come in contact. It can be held on a line by the use of regular clothes-pin clips. This protector has been approved by the National Electric Light Association and by the Bureau of Safety of Chicago.

Wall-Type Pull Switch

A pull switch designed to be mounted on the wall has been perfected by the General Electric Company, Schenectady, N. Y. The mechanism, the makers state, is especially designed for the switch and is not merely an "adapted" snap-switch movement. All the parts are constructed to withstand the abuse of every-day service. The operating mechanism is primarily an eight-tooth ratchet actuated by a pulley whose shaft is parallel to the base to allow a straight pull.

Constant-Frequency Radio Oscillator

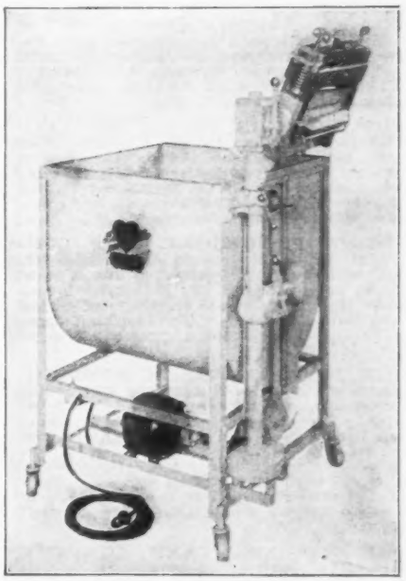
A radio oscillator designed to give a wave form free from harmonics and a constant frequency of 1,000 cycles has been developed by the General Radio Company, Cambridge, Mass. A vibrating fork magnetized with a field coil is used to keep the frequency constant. The output of the oscillator is said to be 0.06 watt. External posts are arranged to give three voltages, 0.5 volt, 1.5 volts and 5 volts. For higher voltages an inductance and capacitance are connected in series across the terminals. The input current at 4 volts to 8 volts averages 0.13 amp.



FORK USED TO KEEP FREQUENCY AT 1,000 CYCLES

Off-Center Cylinder Washing Machine

An offset octagon wooden-slat cylinder is incorporated in the design of the "Berkshire" electric washer made by the Pittsfield Machine & Tool Company, Pittsfield, Mass. The cylinder is rotated around an off-center axis continuously in one direction. The swinging wringer may be tilted while operating so that clothes dropped on its rolls will be drawn in.



HAS PUMP FOR DRAINING

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

CHARLES B. YONTS, who has been well known in the central-station industry in the Middle West, has been appointed manager of the Kansas City branch of the Bluebird Appliance Company, which will handle the retail sales of the Bluebird products. In 1906 Mr. Yonts entered the central-station field with the Illinois Traction System of Peoria. In 1912 he resigned to become connected with the Insull properties as commercial manager, operating in some of the cities served in northern Illinois. In 1918 he became manager of the La Crosse division of the Wisconsin-Minnesota Light & Power Company, which position he held until he became connected with the Bluebird company.

C. B. YONTS

THE DAY BAKER COMPANY, INC., of 110 Arlington Street, Boston, has been assigned the New England agency for the Oneida Motor Truck Company, Green Bay, Wis., manufacturer of both gasoline and electric road trucks.

EDWARD C. RILEY has been transferred from Boston to the Chicago office of the Edison Storage Battery Company, of which he will have charge. His successor in charge of the New England territory is F. I. Starbuck, formerly of the New Haven office of the company.

THE WESTINGHOUSE LAMP COMPANY'S Franklin branch, at Middletown, Conn., will shortly be converted into a plant for the manufacture of miniature incandescent lamps, with a capacity of about 80,000 lamps per day. The working force will be increased from a present total of 250 to 500.

THE JAMES LEFFEL & COMPANY, Springfield, Ohio, manufacturer of turbine waterwheels, on March 15, will move its Boston offices from 79 Milk Street, where it has been for several years, to 161 Devonshire Street. This office will be in charge of A. S. Addison, who for several years was connected with the Boston offices of this firm, but who for the last year has been at the main offices and factories in Springfield, Ohio.

THE HYGRADE LAMP COMPANY, Salem, Mass., will add 20,000 sq.ft. of floor space to its Bridge Street storehouse, to meet the demand for additional stocking facilities and to allow sufficient room for a modern cafeteria, as well as a general assembly room. Mill construction will be used, with wooden walls and asbestos shingles. The storage capacity will be 1,500,000 finished, boxed lamps. Since 1915 the floor space of the Hygrade factory has increased from 14,000 sq.ft. at the old Danvers plant to a total of 80,000 sq.ft., including the 1920 enlargement.

JOHN A. STEVENS, engineer, 8 Merrick Street, Lowell, Mass., has established a branch office at 502-4 Frederick Building, Cleveland, Ohio. Mr. Stevens is prepared to render consulting engineering services for the analysis, design, construction and management of power plants. This office is in charge of Marcus K. Bryan.

THE BROWN INSTRUMENT COMPANY, Wayne and Windrim Streets, Philadelphia, Pa., is making arrangements for extensions to its plant, including the erection of a two-story concrete factory, 44 ft. x 126 ft., and a two-story plant unit, 37 ft. x 72 ft., to be located at Wayne and Roberts Streets. The company manufactures pyrometers and other scientific instruments.

THE ELECTRIC FURNACE COMPANY, Alliance, Ohio, has just opened a Middle Western office at 301 Frisco Building, St. Louis, Mo., in charge of W. E. Prosser. The increasing demand for Baily electric furnaces for melting non-ferrous metals made this step necessary, inasmuch as there are at present sixty units of this type in operation within a radius of 500 miles of St. Louis alone.

THE GEORGE CUTTER COMPANY of South Bend, Ind., announces the acquisition by the Westinghouse Electric & Manufacturing Company of a financial interest in it. The management and the commercial policies will remain unchanged, but advantage will be taken of the Westinghouse engineering and other facilities to expand the Cutter company's activities and develop its lines to enable it to serve more effectively its customers and the industry. The Westinghouse company will operate as sole distributer for the Cutter company's products.

THE BRYANT ELECTRIC COMPANY of Bridgeport, Conn., for a number of years has made two-outlet sockets as a part of its New Wrinkle line. The demand for this device has so materially increased that it has been decided to handle the production and packing of it as a separate complete article and to identify the device by the name "Bryant Dubl-Duty" socket. Each socket is being packed in a three-color carton, which not only facilitates handling but serves to enhance shelf and counter display. In addition a unique counter or window display box is provided for the use of dealers. One of these display boxes, with two dummy containers and a special cradle, is included with each standard package of twenty sockets.

THE FORMICA INSULATION COMPANY of Cincinnati, Ohio, is preparing to remove its plant from 3240 Spring Grove Avenue to 4614 Spring Grove Avenue, where it will have a floor space of approximately 30,000 sq.ft. The change of location will be made sometime in May. The company manufactures high-dielectric moisture-proof permanent electric insulation in sheets, tubes, rods, special shapes and machine parts.

BALDWIN & WELCOMER, general contractors, who have been maintaining offices at Jersey City, N. J., Union City, Pa., and Niles, Ohio, have opened an office at Warren, Ohio, in the Western Reserve Building, which will be known as the main office to take care of their various contracts in the Mahoning Valley. The company does a general construction business, including buildings, industrial and utility plants and systems.

THE A. & W. ELECTRIC COMPANY of Cleveland, Ohio, recently suffered a loss by fire which almost totally destroyed its plant.

THE WHITE LILY MANUFACTURING COMPANY of Davenport, Iowa, has increased its capital stock from $60,000 to $600,000.

JAMES DIXON, formerly with the Crocker-Wheeler Company of Ampere, N. J., has become production manager of the Reliance Electric & Engineering Company of Cleveland, Ohio.

THE YOUNG AMERICA ELECTRIC MACHINE COMPANY of Young America, near West Bend, Wis., has had plans prepared for the construction of a new two-story plant, 44 ft. x 122 ft.

THE WELLINGTON GLASS COMPANY of Cumberland, Md., manufacturer of lighting fixtures, suffered a loss by fire of about $350,000 on Feb. 29. The plant of the company was practically destroyed.

A. L. WILKINSON has resigned as vice-president of the Ohio Brass Company of Mansfield, Ohio. He has been with the company since 1894 and during the twenty-five years since that date has served as salesman, general sales manager, secretary and vice-president, having been elected to the latter office in February, 1919. He contemplates a complete rest for the benefit of his health.

THE MODERN FARM UTILITIES COMPANY has moved into its new quarters at 324 South Nineteenth Street, where it has much more floor space. The company has the agency for the Kewanee products, farm-lighting plants, water system, etc., and carries a line of electrical appliances for the farm. A. L. Green is president of the company and Frank C. Bestor is vice-president and sales manager.

THE TRIUMPH ELECTRIC COMPANY is the name of a new firm of jobbers and engineers at 211 South Third Street, Minneapolis, Minn. H. H. Henley is president of this new organization and with him are associated W. H. Vilett, former president of the Sterling Electric Company, and D. E. Ford. The organization consists largely of the personnel of the former Sterling Electric Company, which has discontinued its electrical jobbing business. The new Triumph Company is carrying a complete stock for a general jobbing business and in addition has organized an extraordinarily active department for building high-tension transmission lines into rural communities. The company expects to go into this branch of the business very extensively.

HOOVER OPENS CANADIAN FACTORY.—A celebration which marked the beginning of active operations in Canada by the Hoover Suction Sweeper Company was staged at Hamilton, Ont., on Feb. 12, by Thomas F. Kelly, Candian sales manager of the company. Mr. Kelly was formerly sales manager of the Dayton (Ohio) Power & Light Company. The photograph shows the first "made in Canada" machine and the department heads of the Canadian company. Mr. Kelly stands directly behind the brush, and W. G. Vogt, office manager, stands directly behind the junction of the bag and the machine.

CANADIAN STAFF OF HOOVER SUCTION SWEEPER COMPANY

THE STEEL DUCT COMPANY, Dollar Bank Building, Youngstown, Ohio, has been recently organized. It expects by April to have on the market a complete line of enameled and galvanized conduit. William B. Curtis, formerly with the Youngstown Sheet & Tube Company, is president.

THE EUREKA VACUUM CLEANER COMPANY of Detroit was awarded the Grand Prix for its vacuum cleaners at the Hygienic Exhibition held in Brussels, Belgium, recently. This is the second time that Eureka vacuum cleaners have won the highest honors. These machines also secured the Grand Prize at the Panama-Pacific Exposition at San Francisco.

THE ELECTROLABS COMPANY, manufacturer of oxygen and hydrogen generating plants, in order to obtain closer cooperation between the factory and the sales department, has decided to consolidate all its offices at 2635 Penn Avenue, Pittsburgh, Pa. The company requests that all correspondence be addressed to its Pittsburgh office. A branch office will be maintained by the company at 30 Church Street. The company also announces that its new catalog is about ready for distribution.

THE H-G MANUFACTURING COMPANY, 1215 Pine Street, St. Louis, Mo., recently organized, will manufacture a line of electrical specialties, including fractional-horsepower motors for operating motor-driven washing machines, etc. Work will be started immediately on the production of small motors. The officers are: J. F. Galvin, president, and A. M. Harrelson, vice-president and treasurer. Mr. Galvin was formerly manager of the St. Louis branch of the Robbins & Myers Company, and Mr. Harrelson was chief engineer of the Emerson Electric Manufacturing Company.

THE ELECTRIC STORAGE BATTERY COMPANY of Philadelphia has arranged for the purchase of 40 acres in Crescentville, in the northeastern part of Philadelphia, on which it will erect a plant to meet the increasing demand for its products. The new buildings, it is reported, are to be used for the manufacture of the products now made by the company, and no venture into new fields is being considered. The company, it is understood, will finance the construction of the proposed new plant out of earnings, as has been its policy in the past. The new plant will be located 4 miles from its present plant at Nineteenth Street and Allegheny Avenue.

THE ENGINEERING & APPRAISAL COMPANY, INC., with offices at 103 Park Avenue, New York, N. Y., has been organized by J. C. Henriques and M. A. Stone, Jr. The company proposes to design and construct mills, factories, power plants and chemical works, to design and develop special machinery and undertake formulation of commercial propositions on which the formation of new manufacturing corporations may be based and also to design and construct industrial plants for every purpose. Mr. Henriques, who is a member of the American Institute of Electrical Engineers, has been engaged for nearly twenty years in the installation, operation and testing of large electrical central stations and distribution systems, as well as in the appraisal and valuation of large works. Mr. Stone is a mechanical engineering graduate of both Yale and Columbia. His special experience has been in the design and construction of buildings and plants for the manufacture of chemical products, oil refining and the production of special gases.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has contracted with Westinghouse, Church, Kerr & Company to build four new buildings at South Philadelphia, Pa. The expansion is intended to take care of the immediate needs incidental to the removal of the machine works (formerly the Westinghouse Machine Company) from East Pittsburgh, Pa. The four buildings will be made of terra cotta and steel, similar in construction and design to the present buildings, and will include a light machine shop, one story, 500 ft. x 130 ft. This building will be used for building small turbines for operating pumps and generators. Machine shop No. 3 will be a duplicate of the present machine shop No. 1, with dimensions of 750 ft. x 130 ft. Very large land and sea steam turbines will be machined in this building. The erecting shop will be extended 300 ft. and will join the new shop No. 3 as it does Nos. 1 and 2. A three-story building, 600 ft. x 50 ft., will be constructed to provide warehouse facilities. The third floor of the building will be used for manufacturing purposes. Nearly all of the machinery necessary for production purposes will be transferred from the Machine Works, East Pittsburgh, and will be directly driven by motors.

THE SYRACUSE WASHING MACHINE CORPORATION, which consists of the reorganized Easy Vacuum Electric Washing Machine Company, is now erecting a new modern fireproof plant on a 25-acre tract of land at Syracuse, N. Y. The factory of the building will be of one-story fireproof construction with the second floor for administrative and executive offices, including a fully equipped cafeteria covering 10,000 sq.ft. of floor space, an auditorium for instruction of workingmen in the different phases of the industry and an experimental department and museum. The officers of the new corporation are: President, J. N. Derschug; vice-president, G. C. Wilkinson; treasurer, H. L. Babcock; secretary, W. A. MacKenzie; assistant secretary and treasurer, S. Stivers, New York. Directors: James M. Gilbert, president Syracuse Trust Company; Walter H. Lippincott, Philadelphia; Frank Ford of Ford, Bacon & Davis, 115 Broadway, New York; W. J. Zuill, W. A. MacKenzie, J. N. Derschug, G. C. Wilkinson, H. L. Babcock. The executive committee consists of Mr. Derschug, Mr. Wilkinson and Mr. Ford.

THE BLACK & DECKER MANUFACTURING COMPANY, Towson Heights, Baltimore, Md., will discontinue the special machinery business and devote all of its energies to an endeavor to keep up with the demand for "lectroflaters," portable electric drills and electric valve grinders, and a new product, the "loadometer," a device for indicating on the dash the amount of load or overload a truck is carrying. A road type loadometer for the use of the State police in detecting violators of the road overloading laws is also to be manufactured. Already plans are under way for erecting another plant building, the same size as the one just completed; new products are in process of development, new manufacturing methods are being perfected, a cafeteria is planned, and plans are being drawn for twenty-five more new houses for employees. The Baltimore plant of the company, at 105 to 115 South Calvert Street, has been sold complete to the Dieffenbach-Westendorf Manufacturing Company, which is composed principally of the older members of the city plant organization. O. W. Dieffenbach, president, was formerly manager of the Baltimore plant; William Westendorf, vice-president and general manager, was superintendent; George M. Kimberly, treasurer, has been treasurer of the Black & Decker Company for a number of years, which position he still holds; John Sonnenleiter, secretary of the new company, was foreman of the milling machine department. The plant of the new company is completely equipped for the manufacture of high-class special machinery and is at present operating two shifts. It is now devoting quite a large portion of its capacity to the overflow from the Towson plant of the Black & Decker Company, which, although recently more than doubled in size, is already contemplating further extensions.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A co-operative supply company in the Netherlands (No. 32,197) desires to secure quotations for the purchase of 5,000 to 10,000 high-tension porcelain supporting insulators for overhead transmission, and request is made for design and description of insulators offered. Correspondence may be in English.

A commercial agent in Italy (No. 32,179) desires to secure an agency for the sale of electrical apparatus, machinery, heating and illuminating apparatus for gas and electricity, motors, automobiles and accessories and food products. Correspondence should be in Italian or French.

An American firm maintaining offices in Mexico, Brazil, Argentina, Berlin and Paris (No. 32,185) desires to secure agencies for the sale of machinery, electrical supplies, automobiles, motor trucks, tractors, railroad equipment, iron and steel, textiles, agricultural implements, chemicals, etc.

W. G. Watson, managing director of W. G. Watson & Company, Ltd., electrical engineers and merchants of Sydney, Australia, will be in the United States shortly, arriving at San Francisco, Cal., on his way to England. Mr. Watson expects to be a few weeks in the United States working his way across the continent.

Trade Publications

ASH CONVEYORS. — The American Steam Conveyor Corporation, 326 West Madison Street, Chicago, Ill., has issued a folder on steam jet ash conveyors.

ELECTRIC SUCTION CLEANERS.—The Apex Electrical Distributing Company, Cleveland, Ohio., has issued a "sales guide" for Apex dealers and salesmen.

CARBON BRUSHES.—The United States Graphite Company, Saginaw, Mich., manufacturer of carbon brushes, is distributing a new catalog, B-2, describing its motor and generator brushes.

OIL CIRCUIT BREAKERS.—Bulletin No. 47,450 of the General Electric Company, Schenectady, N. Y., describes circuit breakers for circuits up to 15,000 volts of moderate capacity.

STREET-LIGHTING FIXTURES.—The General Electric Company, Schenectady, N. Y., has printed a booklet on "Novalux" pendent and bracket street lighting units for series tungsten lamps.

OIL CIRCUIT BREAKERS.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 47,445, describing oil circuit breakers for circuits up to 7,500 volts and currents up to 800 amp.

DIRECT-CURRENT GENERATING SETS.—Engberg's Electric & Mechanical Works, St. Joseph, Mich., have issued catalog No. 103, describing engine-driven direct-current generators of 1-kw. to 50-kw. rating.

New Incorporations

THE SCOTTSVILLE (KY.) UTILITIES COMPANY has been incorporated by Thurman Dixon, A. J. Oliver and W. D. Gilman. The company is capitalized at $40,000.

THE ROSE HILL LIGHT COMPANY of Greenwood, S. C., has been incorporated with a capital stock of $1,500. The officers are: G. Allen Banks, president; T. B. Coleman, secretary, and T. P. McKellar, manager.

THE HARLAN (KY.) ELECTRIC & MACHINE WORKS have been incorporated by G. H. Black, A. C. Jones and F. C. Tarvin to manufacture electrical and mechanical equipment. The company is capitalized at $75,000.

THE STAMPS (ARK.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $20,000. The officers are: J. M. Hudgens, president; L. A. Baker, vice-president, and R. C. Stewart, secretary and treasurer.

THE MANHATTAN INSULATED WIRE & CABLE COMPANY of New York, N. Y., has been chartered with a capital stock of $50,000 by S. A. Morrissey, R. H. Cherry and C. Kurzon, 155 East Houston Street, New York City.

THE RIVERSIDE ENGINEERING COMPANY of Paterson, N. J., has been incorporated by George R. D. Decnyf and George W. Kent. The company is capitalized at $50,000 and proposes to manufacture electrical products.

THE GEORGE F. UHLMAN COMPANY of Binghamton, N. Y., has been incorporated with a capital stock of $25,000 by George F. Uhlman, W. L. Chittenden and W. G. Phelps, Jr. The company proposes to manufacture electric signs.

THE CROTHERSVILLE (IND.) WATER & ELECTRIC COMPANY has been incorporated by W. P. Rider, C. W. Keach and H. B. White. The company is capitalized at $50,000 and proposes to furnish light, heat and power in Crothersville.

THE NON-VACUUM ELECTRODE COMPANY of New York, N. Y., has been incorporated by H. J. Sondheim, M. B. and H. A. Conem, 51 Chambers Street, New York, N. Y. The company is capitalized at $50,000 and proposes to manufacture electrodes.

THE MODERN ELECTRIC WELDING COMPANY, 915 South Ann Street, Baltimore, Md., has been incorporated by Daniel J. Lynch, John M. Hoffman and Milton Roberts. The company is capitalized at $100,000 and proposes to do a general electric welding business.

New England States

HINSDALE, N. H.—The Connecticut River Power Company, 35 Harvard Street, Worcester, Mass., contemplates the enlargement of its hydro-station at Hinsdale, including the installation of four additional units. C. A. Harris, Brattleboro, Vt., is president.

MANCHESTER, N. H. — Preliminary steps have been taken by the Amoskeag Manufacturing Company toward the construction of a new dam and power house on the Merrimac River. The equipment will include two waterwheels of 7,500 hp. each. The estimated cost is $500,000.

PLAISTOW, N. H.—The Plaistow Electric Light & Power Company is considering plans for the construction of a street-lighting system.

JOHNSON, VT.—The installation of a generator and switchboard in the municipal electric light plant is under consideration.

CONCORD, MASS.—Extensive improvements are contemplated to the municipal electric plant, including complete renewal of boiler plant, piping and accessories.

NORTHAMPTON, MASS.—In connection with the construction of the new hospital for which the Lathrop Home, 236 South Street, will soon award contracts considerable electrical equipment will be required. The cost is estimated at about $250,000. G. F. Newton, 6 Beacon Street, Boston, is architect.

SPRINGFIELD, MASS.—The construction of a new three-story, 44-ft. x 80-ft. substation is contemplated by the United Electric Light Company, 73 State Street. W. L. Mulligan is manager.

WORCESTER, MASS.—The Worcester Electric Light Company contemplates the installation of three additional 1,250-hp. Bigelow-Hornsby boilers in its Webster Street power plant. This project, with other improvements, will involve an expenditure of several thousand dollars. R. W. Rollins is the general manager.

PROVIDENCE, R. I.—The Narragansett Electric Light Company, 800 Turk's Head Building, is preparing to construct an addition to its power house on South Street and will install eight new boilers and generators. The project will cost approximately $700,000.

WESTBROOK, CONN.—Complete electrical equipment will be required in connection with the with the new suspender factory that Knothe Brothers Company, 124 Fifth Avenue, New York, N. Y., plan to build in Westbrook at an approximate cost of $120,000. Fletcher-Thompson, Inc., 1089 Broad Street, Bridgeport, are architects.

Middle Atlantic States

ADDISON, N. Y.—The Addison Electric Light & Power Company plans to install a new steam unit. M. G. Hubbs is secretary.

BUFFALO, N. Y.—The Buffalo General Electric Company, Electric Building, plans to extend its transmission system. R. McMillan is statistician.

BUFFALO, N. Y.—Bids will be received until March 29 by the Commissioner of Parks and Public Buildings, Municipal Building, for sundry electrical equipment, including wire, conduits and switchboards, to be used by the Fire Department staff in the wiring of thirty-nine fire houses in Buffalo. The cost will be about $17,000.

CALEDONIA, N. Y.—The Livingston-Niagara Power Company of Avon contemplates the construction of a street lighting system for the village of Caledonia. D. M. Lewis is secretary.

CENTRAL ISLIP, N. Y.—Bids will be received April 7 by the State Hospital Commission, E. S. Elwood secretary, Capitol, Albany, for construction of a fire-alarm system in Central Islip State Hospital, at an approximate cost of $10,000. Specifications may be obtained from L. F. Pilcher, state architect, Capitol, Albany.

ELMIRA, N. Y.—The Elmira Water, Light & Railroad Company contemplates the installation of a 6,000-kw. turbine and a 786-hp. boiler, as well as transmission-line extensions. F. H. Hill is manager.

JAMAICA, N. Y.—Steps have been taken by the Jamaica Board of Trade to establish an ornamental lighting system on the principal streets.

NORWICH, N. Y.—The New York State Gas & Electric Corporation is considering the installation of a new generating unit, and a three-phase, 10-mile transmission line extension. B. Diamond is superintendent.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

RICHMOND, N. Y.—Bids will be received until March 26 by C. B. J. Snyder, superintendent of School Buildings, Municipal Building, Manhattan, for installation of electrical equipment in new Public School 11, Dongan Hills, Borough of Richmond.

SCHENECTADY, N. Y.—The General Electric Company, River Road, contemplates the construction of a completely equipped punch-press shop to cost about $700,000.

SOUTH RIVER, N. J.—Bids will be received by the Board of Public Works until April 12 for design and construction of an addition to the generating station, including machinery and equipment. Goss, Bryce & Johnson, 55 Liberty Street, New York, N. Y., are engineers. E. B. Hedden is superintendent. For details see Searchlight Section.

TRENTON, N. J.—Considerable electrical equipment will be required in connection with proposed theater to be erected in Perry Street by W. J. Vernon, St. Regis Building, to cost about $500,000. W. W. Slack & Son, St. Regis Building, are architects.

DOVER, DEL.—Bids will be received until March 24 by the City Council for improvements and extension to the municipal light plant, to cost about $89,000.

PHILADELPHIA, PA.—The Queens-Brooks Company, American and Diamond Streets, contemplates the erection of a five-story underwear factory at Fifth Street and Huntington Place, to cost about $100,000. Considerable electrical equipment will be required. W. E. S. Dyer, Land Title Building, is architect and engineer.

PITTSTON, PA.—The Pennsylvania Coal Company of Pittston plans to build an electric power plant, 30 ft. high, to cost about $200,000, in connection with the construction of its new coal breaker.

ST. MARYS, PA.—The St. Marys Electric Light Company plans to build 10 miles of 22,000-volt transmission line. W. H. Brown is superintendent.

WILKES-BARRE, PA. — The Vulcan Iron Works, 730 South Main Street, contemplate building a locomotive shop on Hazel Avenue, at an estimated cost of $130,000. Motors and other electrical equipment will be required. E. D. Rineheimer, Carlisle Street, is engineer.

SPARROW'S POINT, MD.—A new power plant is included in the proposed additions to the local plant of the Bethlehem Steel Corporation. The cost of the work is estimated at about $1,000,000.

North Central States

DETROIT, MICH.—Considerable electrical equipment will be required by B. B. Jacobs, Penobscot Building, in connection with the construction of a ten-story hotel addition at Park Boulevard and Elizabeth Street, to cost about $1,000,000.

DETROIT, MICH.—The Superior Machine & Engine Company, 51 East Fort Street, will require motors for power and other electrical equipment in connection with the construction of a proposed three-story factory at East Larned and St. Aubin Streets, to cost about $100,000. Brown & Preston, 406 Empire Building, are architects.

FLINT, MICH.—Van Leyen, Schilling, Keough & Reynolds, architects and engineers, Union Trust Building, Detroit, representing owners (name withheld), are preparing plans for a new theater building on Detroit Street, to cost about $100,000. The project calls for considerable electrical equipment.

HAMTRAMCK, MICH.—Complete electric lighting equipment will be required for the two-story municipal hospital to be erected by the village of Hamtramck, at a cost of about $150,000. A. E. Harley, 435 Woodward Avenue, Detroit, is architect.

OXFORD, MICH.—Plans are under consideration to rebuild the municipal electric distribution system. E. A. Detwiler is clerk.

SAGINAW, MICH.—The Board of Education is having plans prepared by Cowles & Mutscheller, 10 Chase Block, for the erection of a two-story junior high school, requiring considerable electrical equipment. The cost is estimated at $1,000,000.

SAGINAW, MICH.—The Modart Corset Company, 309 Lapeer Avenue, contemplates the erection of a four-story mercantile building on Lapeer Avenue, to cost about $300,000. Equipment for electric lighting and elevator control will be required. Cooper & Beckbissinger, 114 South Jefferson Avenue, are architects.

YALE, MICH.—The installation of an additional 75-kw. unit generator in the municipal electric light and water plant is under consideration. A. T. Kent is superintendent.

CINCINNATI, OHIO.—The installation of one new 33,000-kva. unit and the construction of approximately three miles of 13,200-volt eight-duct underground conduit, as well as one 6,000-kw. outdoor substation and about 20 miles of 33,000-volt, three-phase transmission line to Milford and Loveland, is contemplated by the Union Gas & Electric Company. W. W. Freeman is president.

CLEVELAND, OHIO. — Considerable electrical equipment will be required by the Beckman Company, 3167 Fulton Road, in connection with the two-story weaving factory it plans to build on Fulton Road and West Thirty-third Street, at a cost of approximately $400,000. Lockwood-Gowen & Company are engineers and arichtects.

CLEVELAND, OHIO — The Cleveland Railway Company is having plans prepared for the construction of a new one-story substation at East 139th Street and Woodland Avenue, to cost about $75,000. D. W. Morrow, 4500 Euclid Avenue is architect.

CLEVELAND, OHIO.—The Hubbell Tire & Rubber Company, 6545 Carnegie Avenue, is in the market for a 10-kw. motor-generator set, including a four-pole, compound-wound 220-volt, direct-current, 900-r.p.m. generator, to connect with a 15-hp., three-phase, 60-cycle, 400-volt, 900-r.p.m. induction motor, with starting device and flexible coupling between motor and generator.

CLEVELAND, OHIO.—Bids will be received until March 22 by the Gordon Square Company, M. Eyerdam manager, West Sixty-fifth Street and Detroit Avenue, for construction of commercial building, including theatre and market, for which electrical motors, wiring and elevator equipment will be required; also the installation of boilers and refrigerating system. The approximate cost is estimated at $300,000. B. H. Prack, Keystone Building, is engineer.

EAST PALESTINE, OHIO.—The installation of a 300-hp. water-tube boiler in the municipal electric plant is contemplated. J. Ashman is president.

JACKSON, OHIO.—The Wellston Iron Furnace Company is in the market for 100-hp., direct-current, 250-volt motor.

NEWARK, OHIO.—Newark Telephone Company contemplates the erection of six telephone substations on various sites at a total cost of about $48,000. M. Peterman, 321 East Gay Street, Columbus, is architect.

SABINA, OHIO.—Transformers to furnish 230-volt three-phase service will probably be installed in the municipal water and light plant. J. C. Phelps is the superintendent.

WADSWORTH, OHIO.—The installation of one 400-kva. General Electric generator and Skinner engine in the municipal light, water and ice plant is under consideration. Carl Stauffer is superintendent.

WHITEHOUSE, OHIO.—The Whitehouse Electric Company contemplates extending its electrical service into the outlying districts. L. A. Harris is manager.

GEORGETOWN, KY.—Bonds to the amount of $100,000 have been authorized for improvements to the city electric light and power plant and waterworks. W. H. Weiss, City Hall, is consulting engineer and C. L. Sebree is city clerk.

SOUTH BEND, IND.—The Indiana & Michigan Electric Company of South Bend has increased its capital stock from $5,000,000 to $11,500,000.

BLOOMINGTON, ILL.—Bids will be received until April 2 at the office of the supervising architect, Washington, D. C., for rewiring, etc. in the United States post office at Bloomington, Ill. Specifications may be obtained from this office or from the office of the custodian, Bloomington, Ill. For details see Searchlight Section.

AMHERST, WIS.—The Amherst Electric Service Company contemplates the installation of a 100-kva. generator and a 50

hp. or 75-hp. oil engine. B. E. Dwinnel is the manager.

MEDFORD, WIS.—The Medford Light & Heating Company plans to install a new generator. W. Ungrodt is superintendent.

ROME, WIS.—The Bark River Electric Service Company contemplates erecting a 20-mile transmission line. A. N. Becker is president.

SOLDIERS' GROVE, WIS.—The Soldiers' Grove Electric Company is planning to change its system from direct-current to alternating current. T. Sime is manager.

REINBECK, IOWA.—Charles C. Camp, owner of the electric light plant, contemplates the installation of about sixty ornamental single-lamp standards in the business district.

WEST BRANCH, IOWA.—The Board of Education, T. A. Moore, secretary, plans to build a three-story school at a cost of about $125,000. A separate contract will be awarded for electrical equipment, to include wiring, switches, fuses, etc. Proudfoot, Bird & Rawson, 810 Hubbell Building, Des Moines, are architects.

KANSAS CITY, MO.—The Kansas City Power & Light Company has acquired a site south of Kansas City terminal tracks on Summit Street, on which it will erect a new warehouse building, garage, etc., to cost about $250,000.

LEADWOOD, MO.—Contract for a new 5,000-kw. steam-driven electric power plant with complete electrical and mechanical equipment, including jet condenser with auxiliaries, two boilers, 12-ft. x 200-ft. brick stack, pulverized-coal equipment, conveyors, piping, etc., has been awarded the Stone & Webster Engineering Corporation, 147 Milk Street, Boston, Mass., by the St. Joseph Lead Company. The project will cost about $800,000.

SARCOXIE, MO.—The Southwest Electric Light & Milling Company contemplates the installation of one 112½-kva. generator and a transformer. A. Adams is president.

GARRISON, N. D.—The Garrison Light & Power Company is considering the installation of a 150-hp. boiler and a 100-kw. direct-connected generator. J. A. Kunkel is the secretary.

LARIMORE, N. D.—Improvements are contemplated to the municipal electric light and power plant, including the installation of a three-phase, 60-cycle, 2,300-volt generator and an entire new distribution system. The system will be changed from direct to alternating current.

MICHIGAN, N. D.—The Municipal Electric Light Company contemplates increasing the generating capacity of its plant. H. J. Harrison is superintendent.

WALLHALLA, N. D.—The owners of the local electric light plant contemplate extending their lines into the farming district. W. A. Andrews is in charge.

WILLISTON, N. D.—The installation of a fifty-lamp series street-lighting system, including a switching station, is under consideration by the Water and Light Department.

ARMOUR, S. D.—The South Dakota Light & Power Company contemplates the installation of one 500-hp. oil engine, of either Diesel or semi-Diesel type, and one 300-hp. producer. G. W. Welch is superintendent.

FLANDREAU, S. D.—The Dakota Light & Power Company is considering several rural extensions to its transmission lines. A. H. Bushman is superintendent.

HIGHMORE, S. D.—Plans are under consideration to change the municipal electric light system from direct to alternating current.

IROQUOIS, S. D.—The Iroquois Electric Light Company contemplates the installation of a 50-hp. engine directly connected to a 42-kva., 2,300-volt, three-phase, 60-cycle generator. W. H. Jordan is president.

MILBANK, S. D.—The Milbank Power Company is considering the installation of a 400-hp. Rathbun engine and generator. F. A. Barnard is the manager.

MINDEN, NEB.—Bids will be received until March 20 by J. M. Markussen, city clerk, for extensions to municipal water and light plant to cost about $37,000.

Southern States

BELMONT, N. C.—Large quantities of electric equipment, including motors for individual drive, it is understood, will be required in connection with the proposed new plant of the Stowe Spinning Company.

BAMBERG, S. C.—Preparations are being made to equip the local mills of the Santu Cotton Mills Company for electrical operation.

CHESTERFIELD, S. C.—The Teal Light & Power Company contemplates the installation of an additional generating unit. D. T. Teal is manager.

WALTERBORO, S. C.—The Waterboro Water, Light & Power Company contemplates the installation of a 75-kva. generator and engine directly connected. C. Binns is manager.

CARTHAGE, TENN.—The Smith County Electric Company contemplates the construction of an 11-mile transmission line to Monoville, Riddleton and Dixon Springs. R. S. Seese is manager.

COAL CREEK, TENN.—The Black Diamond Collieries contemplates the installation of a 225-kva. or 325-kva., three-phase, 60-cycle, 2,300-volt generator directly connected to engine.

DICKSON, TENN.—The installation of a complete new generating unit in the municipal electric light plant is under consideration. E. S. Payne is superintendent.

MONTEREY, TENN. — The Monterey Light & Power Company contemplates the installation of a 60-hp. engine and a generator; also a number of short extensions to its distribution system. L. C. Parks is manager.

FRIARS POINT, MISS. — The Friars Point Light, Water & Ice Company contemplate the installation of a power plant in connection with a new building. The cost of the machinery is estimated at $180,000. Minor C. Lyon is proprietor.

IOTA, LA.—Bonds to the amount of $44,000 have been voted for the construction of electric light plant and waterworks system.

ALTUS, OKLA.—The installation of an additional 700-kva. engine and high-pressure boilers in the municipal water and light plant is contemplated. C. A. Welch is superintendent.

CARMEN, OKLA.—The construction of a ten-mile transmission line to Helena is contemplated by the Electric Light & Water Department. H. A. Kenderson is superintendent.

ENID, OKLA.—Plans are under consideration by city officials for the installation of a municipal electric lighting system, including a power house, to cost about $500,000. Black & Veatch, Interstate Building, Kansas City, Mo., are consulting engineers.

LEVERNE, OKLA.—The City Light Department contemplates the installation of 2,400-volt alternators in the municipal electric plant and of transformers in the transmission system. C. H. Arbuthnot is superintendent.

MARLOW, OKLA.—The City Council is considering the installation of an ornamental street-lighting system. S. A. Anthony is superintendent.

MIAMI, OKLA.—The installation of an additional Diesel engine-driven unit in the municipal electric light and water plant is under consideration.

PRAGUE., OKLA.—The erection of additional 33,000-volt transmission lines is contemplated in connection with the municipal electric light and water plant. O. Vaught is superintendent.

WEATHERFORD, OKLA. — The erection of a 9-mile transmission line with transformer in connection with the municipal electric plant under consideration. G. A. Griechfield is manager.

ABILENE, TEX.—Abilene Gas & Electric Company plans the construction of a new 2,500 kw. generating plant. J. W. Dawley is manager.

BASTROP, TEX.—The Bastrop Water Light & Ice Company is considering the installation of one 150-kva. generator. J. E. Haines is the superintendent.

CISCO, TEX.—The Cisco Gas & Electric Company will build a transmission line to Abilene. P. W. Campbell is manager.

GORDON, TEX.—The Gordon-Mingus Light Company is considering the installation of a 50-hp. generating unit. S. W. Daws is the manager.

HENDERSON, TEX.—The Henderson Cotton Oil & Gin Company is planning the construction of a complete new generating plant. O. E. Morris is manager.

LOMETA, TEX.—Lometa Light & Power Compay is considering the installation of an additional oil engine and generating unit. M. D. Melear is manager.

MARSHALL, TEX.—The Marshall Electric Company contemplates the installation of one 1,500-kw. turbo-generator. W. Campbell is manager.

PALACIOS, TEX.—The installation of one 75-kva. unit in the municipal generating plant is under consideration. M. Lipscomb is superintendent.

SAN BENITO, TEX. — The Commonwealth Water & Electric Company contemplates the installation of a 200-hp. generating unit. A. L. Harris is manager.

PERRYTOWN, TEX. — The Perrytown Public Utilities Company, recently incorporated with a capital stock of $25,000, contemplates the erection of an electric light plant. C. E. Whippe and others are the incorporators.

SNYDER, TEX. — The Snyder Utilities Company, recently organized with a capital stock of $50,000, will take over the Snyder electric light plant. Plans for enlargement and improvement are under way. D. P. Yoder and others are incorporators.

Pacific and Mountain States

CLARKSTON, WASH. — The Idaho-Washington Light & Power Company, 825 Trent Street, Spokane, contemplates extending its transmission lines to Culdesac a distance of 9 miles. F. J. Keys is the manager.

DAYTON, WASH. — Steps have been taken by the City Council and the Commercial Club to secure establishment of a steam auxiliary electric generating plant on a local site, or to obtain transfer of plant now operating at Kennewick.

VANCOUVER, WASH.—The Spirit Lake Railway & Power Company, recently incorporated, contemplates the construction of a power house with a capacity of 44,000 hp. at Spirit Lake, about 40 miles east of this city. The estimated cost is $2,000,000. The construction of an electric railroad from Vancouver to Puget Sound, with branches running into Portland, Grays Harbor and Willapa Harbor is also under consideration. Dr. J. Roan of this city is one of the trustees.

WENATCHEE, WASH.—The installation of a pumping system, including one or more 25,000-gal per-minute pumps, with 470 ft. lifting capacity, to cost about $10,000 is contemplated by the Okanogan Valley Irrigation Project. D. C. Heney, Spaulding Building, Portland, Ore., is consulting engineer. J. S. Peterson of Omak is representative of property holders.

ENTERPRISE, ORE.—A. J. McInturff & Son have filed application with P. A. Cupper, state engineer, for permission to appropriate 100 second-feet of water from the Wallowa River. The plans provide for a development of 682 hp. and include dam, wasteway, headgate, tunnel pipe, etc., to cost about $57,700.

GRANT'S PASS, ORE. — The Grant's Pass Irrigation District has had plans approved by P. A. Cupper, state engineer, Salem, for the installation of a temporary pumping plant, to cost about $106,000.

PORTLAND, ORE.—C. J. Schnabel, representing owner, Chamber of Commerce Building, has filed application with P. A. Cupper, state engineer, to appropriate 600 second-feet of water from the Santiam River. The plans provide for construction of a manufacturing and lighting plant, to include the development of 6,511 hp. and the erection of a dam, headgate, canal and steel pipe lines, to cost about $800,000.

HAYWARD, CAL.—The Water Department is making tentative plans for the purchase of the Hayward Water Company's system. Improvements, to include the replacing of steam pumping plant with electric pumping system are contemplated. The cost will be approximately $100,000.

LOS ANGELES, CAL.—Bids will be received by the Public Service Commission until April 6, for furnishing hydraulic equipment, generators and auxiliary electrical equipment, to cost about $175,000. E. F. Scattergood, 645 South Olive Street is the engineer.

MODESTO, CAL.—Bonds to the amount of $2,000,000 will be issued for the Modesto Irrigation District's share in the construction of the Don Pedro reservoir, power plant and transmission and distribution system and the enlargement of the present canal.

HARRISON, IDAHO — Bonds to the amount of $10,000 have been voted for a new lighting system.

MYTON, UTAH.——The Utah Power & Light Company contemplates the construction of a new power plant and transmission lines to connect with six small towns. J. H. Colthorp is the manager.

BUTTE, MONT.——The Department of Public Works plans to extend the street-lighting system. E. J. Strasburger is the commissioner.

GILLETTE, WYO.—The installation of an engine and a 166-kva. generator in the municipal light plant is under consideration. M. L. Thomas is manager.

Canada

EDMONTON, ALTA.—An expenditure of $750,000 for power plant extensions is recommended by the City Commissioners.

LADYSMITH, B. C.—The installation of a 50-kw., 220-volt, 60-cycle, three-phase generator and a Diesel engine in the municipal electric plant is under consideration. M. A. Morrison is city clerk.

SHOAL LAKE, MAN.—The installation of an additional generating unit in the municipal electric plant is contemplated. A. R. Ibbotson is engineer.

CAMPBELLFORD, ONT.—In order to supply 600 hp. additional, the transmission voltage in the municipal electric plant is to be raised to 6,600 volts. J. Carr is engineer.

ISLINGTON, ONT.—Plans are being prepared by E. A. James Company, engineers, 31 Toronto Street, Toronto, for a complete new waterworks system, including electrically operated centrifugal pumps, to cost about $85,000

LISTOWEL, ONT.—The Public Utilities Commission plans to install new street-lighting equipment. W. R. Reynolds is superintendent.

MANOTICK, ONT.—The Hydro-Electric Power Commission of Ontario will be asked to supply electricity in the entire district around Manotick.

ORILLIA, ONT.—The Water, Light & Power Commission contemplates the rebuilding of two 22,000-volt transmission lines. S. H. Starr is engineer.

STRATFORD, ONT.—Kindel Brothers Company, Ontario Street, plan to build a boiler house, with complete electrical equipment, including one 250-hp. horizontal return tubular boiler with feed-pump, water heater, etc. J. Russell, Downie Street, architect. The cost is estimated at $18,000.

SUTTON, ONT.—The question of securing electricity from the Hydro-electric Power Commission of Ontario in the town of Sutton is under consideration.

TORONTO, ONT.—Bids will be received until April 20 by R. C. Harris, city engineer, City Hall, for the installation of an electrically operated centrifugal pump to be used in the sewerage system.

WALKERVILLE, ONT. — The Hydro-Electric Commission contemplates an additional power feeder of 2,000 kva. capacity and a lighting feeder of 7,500 kva. for the local transmission system. M. T. McHenry is manager.

DRUMMONDVILLE, QUE.—The Jenckes Spinning Company of Pawtucket R. I., is erecting a tire-fabric plant in Drummondville, to cost about $1,000,000. The Loomis Daekin Engineering Company of Sherbrooke is contractor. The proposed plant will give employment to approximately 1,000. Through mistake this item appeared under Montreal in the isue of Feb. 14.

MOOSEJAW, SASK.—The installation of water-tube boilers in the municipal light and power plant is under consideration. J. D. Peters is manager.

Record of Electrical Patents

Notes on United States Patents

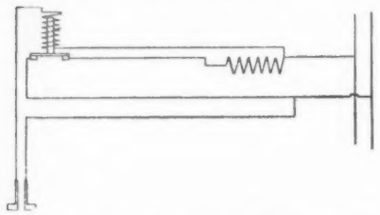
(Issued March 2, 1920)

1,332,208. MEASURED-SERVICE TELEPHONE SYSTEM; John Erickson, Chicago, Ill. App. filed Feb. 11, 1918. Coin-collecting device used with party line.

1,332,221. ELECTRIC COOKER; James E. Lappen, Winona, Minn. App. filed Feb. 20, 1917. Also serves as table.

1,332,222. AUTOMATIC TELEPHONE SYSTEM; Alben E. Lundell, New York. App. filed April 13, 1918. Quick-acting switches in exchange of large capacity.

1,332,226. COMMON-BATTERY AUTOMATIC TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Jan. 4, 1906. Improved repeater makes trunk-line connection between exchanges.



No. 1,332,696—Alternating-Current Circuit Breaker for Motors

1,332,241. ELECTRODE HOLDER FOR USE IN ELECTRIC ARC WELDING OR CUTTING; Charles B. Waters, New York, N. Y. App. filed July 18, 1918. For several sizes of electrodes.

1,332,275. TELEPHONE SYSTEM; Hans Steidle, Munich, Germany. App. filed Oct. 5, 1914. Simplifies mechanism provided for branch exchanges with restricted service.

1,332,307. METHOD FOR COATING WITH TIN AND TIN ALLOYS ARTICLES MADE OF ALUMINUM OR ALUMINUM ALLOYS; Michele N. Salvati, Turbin, Italy. App. filed Nov. 15, 1918. First coats aluminum articles with iron layer by electrolytic method.

1,332,312. ELECTRICAL POSITION INDICATOR; Harry L. Tanner, Brooklyn, N. Y. App. filed June 5, 1915. Indicates range of distant object.

1,332,322. SIGNALING DEVICE; Frederick W. Cole, Newton Highlands, Mass. App. filed Jan. 12, 1917. Motor-driven vibratory diaphragm for out-of-door use.

1,332,379. CIRCUIT CONNECTOR; Carl Bramming, Chicago, Ill. App. filed Feb. 19, 1917. Plug-and-socket type.

1,332,394. METHOD OF ELECTRIC WELDING; Louis Gruber, Dayton, Ohio. App. filed March 14, 1918. Dowel pin subjected to welding heat.

1,332,403. CAR-CONTROL MECHANISM; John S. McWhirter, New York, N. Y. App. filed Feb. 18, 1919. Manual control for safety cars.

1,332,414. SYNCHRONIZER; Melvin L. Severy, Arlington Heights, Mass. App. filed March 8, 1913. Controls speed of pulsation-producing devices in musical instruments.

1,332,422. PROCESS FOR THE MANUFACTURE OF CEMENTS AND SIMILAR PRODUCTS; Maurice L. Boillot and Jean Daudignac, Moutiers, France. App. filed June 28, 1918. Integral fusion in electric furnace.

1,332,434. ELECTRIC POWER TABLE; Samuel Desure, New York, N. Y. App. filed March 6, 1919. For sewing machines, etc.

1,332,463. VARIABLE INDUCTANCE; Harold P. Donle, Meriden, Conn. App. filed Dec. 15, 1917. Adjusted throughout wide range.

1,332,464. ELECTRICITY METER; Jesse Harris, Lafayette, Ind. App. filed Nov. 14, 1918. Motor-driven counting trains, damping magnets and disks.

1,332,482. BATTERY-TERMINAL CONNECTOR; Charles J. Baker, Elkhart, Ind. App. filed March 10, 1919. For flashlights.

1,332,483. SEA-WATER BATTERY FOR VESSELS; Arthur Bridge, Washington, D. C. App. filed May 29, 1919. Primary battery suitable for submarine boats.

1,332,526. ELECTRIC TABLE HEATER; John K. Soden, Portland, Ore. App. filed June 21, 1918. Grid type with closed chamber at base containing water to conserve heat.

1,332,555. SWITCH CABINET; Arthur T. Hunt, Chicago, Ill. App. filed Jan. 5, 1918. For industrial-plant lighting circuits.

1,332,563. METHOD OF ELECTRIC WELDING AND PRODUCT THEREOF; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed Nov. 25, 1919. Welds metal inner tube to metal outer tube.

1,332,564. TELEPHONE-LOCKING DEVICE; Trevor G. Murton, Detroit, Mich. App. filed March 19, 1919. Prevents unauthorized use.

1,332,610. ELECTRIC SYSTEM; John L. Creveling, White Plains, N. Y. App. filed Aug. 28, 1916. Auxiliary battery operates translating device when current fails.

1,332,631. SUBMARINE-PROPULSION SYSTEM; Robert V. Morse, Ithaca, N. Y. App. filed Feb. 5, 1916. Increases cruising radius.

1,332,652. MAGNETO GENERATOR; Richard Varley, Englewood, N. J. App. filed April 26, 1919. Shifts field poles.

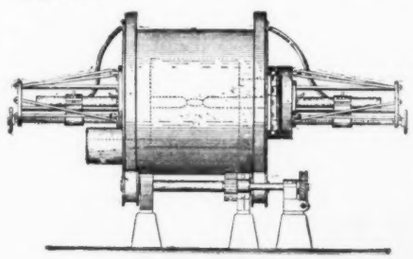
1,332,658. ELECTRIC HEATING AND BENDING DEVICE; George E. Barstow, Lynn, Mass. App. filed Aug. 20, 1918. Bending cutting edges of rotary cutters for trimming heels in shoe manufacture.

1,332,670. METHOD OF PLUGGING HOLES IN METAL PLATES; Maurice Lachman, New York, N. Y. App. filed Oct. 19, 1918. Rivet forms part of secondary.

1,332,688. INTERMEDIATE CONDUCTOR FOR ELECTRIC METAL-WORKING APPARATUS; Adolph F. Rietzel, Charleston, R. I. App. filed Oct. 3, 1918. Connection transmits heavy currents and permits free movement of jaws.

1,332,696. AUTOMATIC CIRCUIT BREAKER FOR MOTORS; Arthur C. Tabbot, Atlanta, Ga. App. filed April 29, 1918. Breaker acts when armature bearings become worn.

1,332,707. ELECTRICAL GENERATING SYSTEM; William W. Bucher, Chicago, Ill. App. filed June 2, 1916. Both low and high voltage through single armature with brushes operating on separate commutators.



No. 1,332,795—Electric Furnace

1,332,757. INDUCTION COIL; Rudolf Rosner, Chicago, Ill. App. filed Feb. 23, 1918. Annular core of thin, flat soft-iron strips.

1,332,795. ELECTRIC FURNACE; William K. Booth, Chicago, Ill. App. filed Feb. 3, 1919. Revolving type.

1,332,810. COMBINED AIR-SPEED METER AND ANGLE OF INCIDENCE AND SIDE-SLIP INDICATOR, WITH DIAL THEREFOR; Oscar A. Danielson, New York, N. Y. App. filed Feb. 3, 1917. Indicating altitudes of aeroplane with relation to currents through which it passes.

1,332,844. AUTOMATIC TIMING DEVICE; Charles L. Kasson, Mattapan, Mass. App. filed Sept. 11, 1918. Measures time settings of relays.

1,332,852. ELECTRICAL HEATING ELEMENT; Henri G. Levy, San Francisco, Cal. App. filed Sept. 18, 1917. For hair dryers.

1,332,860. COUMARONE-RESIN INSULATING MATERIAL; Alfred A. Wells, Caldwell, N. J. App. filed April 9, 1917. Molded insulator.

1,332,862. ALTERNATING-CURRENT RECTIFIER; Frank W. Adsit, Minneapolis, Minn. App. filed Oct. 22, 1915. Pulsating wave taken from direct-current side symmetrical in each half cycle.

1,332,867. ELECTRIC LAMP SOCKET; Gustave Frankel, New York, N. Y. App. filed Jan. 13, 1919. Double outlet type.

1,332,868. FLASHLIGHT; Gustave Frankel, New York, N. Y. App. filed May 12, 1919. Continuous or intermittent light.

1,332,873. TELEPHONE TRANSMITTER; Peter L. Jensen, San Francisco, Cal. App. filed Jan. 2, 1918. For aeroplane use.